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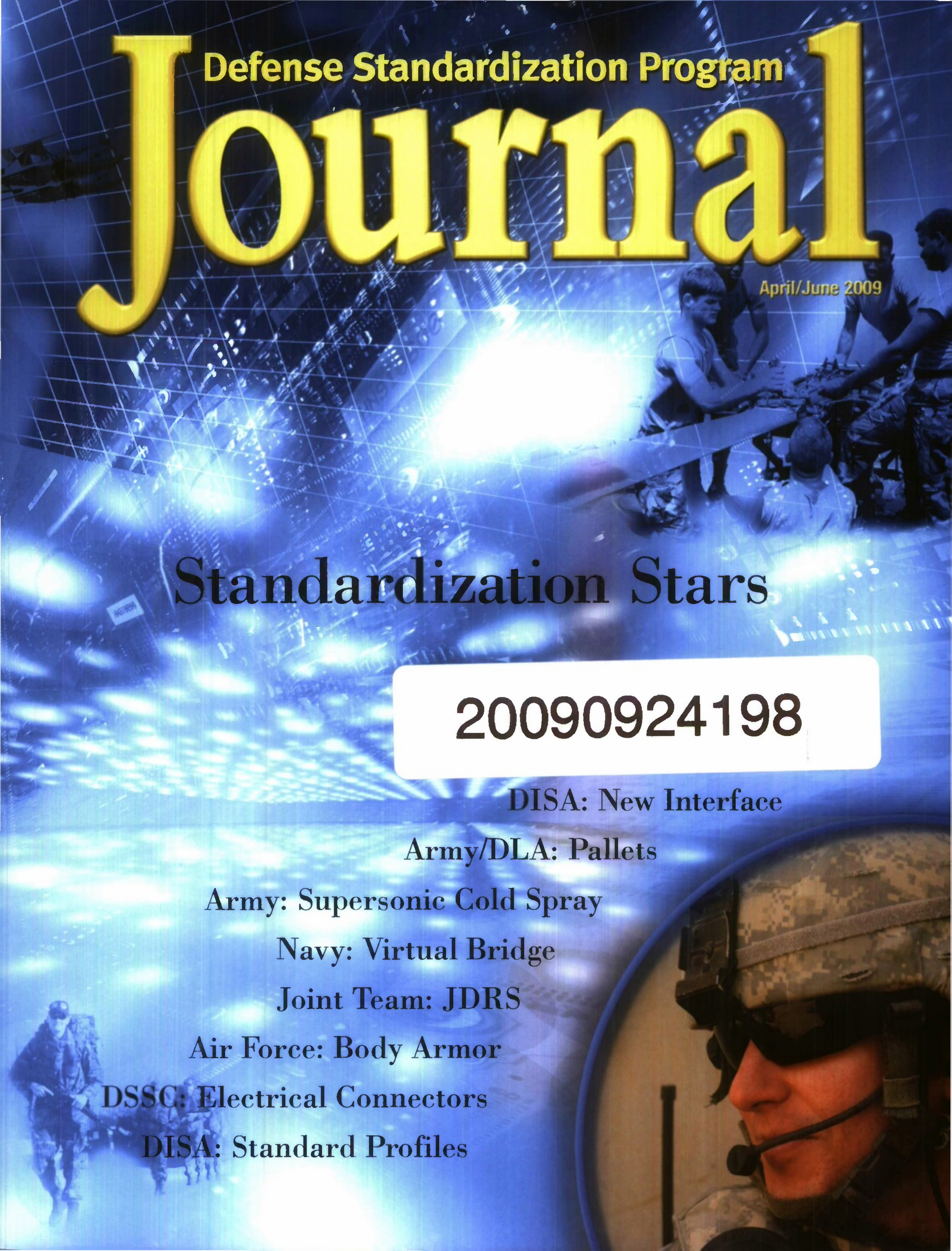

Defense Standardization Program

Journal

April/June 2009

Standardization Stars

Defense Standardization Program
Journal

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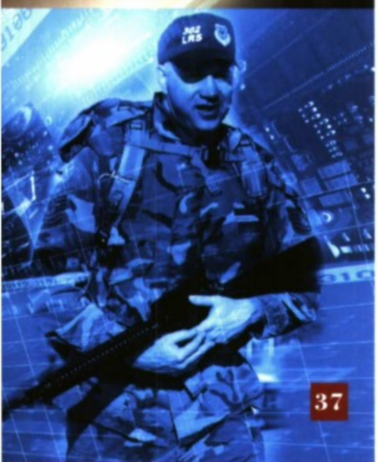

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Director's Forum

Recognizing Achievements in Standardization

Standards have been, and will always be, an integral part of planning for warfighting capabilities. Each year, this statement is reinforced as we recognize, at our annual awards ceremony, individuals and teams who have significantly improved technical performance, enhanced safety, or eliminated cost.

At this year's event, Mr. Alan Estevez, Principal Assistant Deputy Under Secretary of Defense for Logistics and Materiel Readiness, said, "You recognize the need for standards once they're gone." As he delivered the keynote address, he used examples of different adaptors needed in order to plug in a common electric razor when traveling overseas. The collection of adaptors that he brought with him illustrated how different standards used in different countries can complicate even very simple, mundane tasks. And, while the different adaptors all allow the razor to work, one can imagine the logistical and economic factors to take into consideration when traveling abroad. The same holds true in supporting weapon systems. The ability of our systems to be interoperable with allied forces is paramount to achieving mission success. By standardizing upfront, we reduce unnecessary duplication, and though the razor example may seem quite pedestrian, it drives home what we do—make systems work together.

An excellent example of making systems work together can be seen in this year's Distinguished Achievement Award winner. Mr. Tim Sharpe, of the Defense Information Systems Agency, recognized that international peacekeeping operations will require future military operations to be multinational efforts. NATO nations realized that improving the level of interoperability among their tactical communications systems is essential to the success of future operations. Mr. Sharpe worked within NATO to establish and chair a working group that coordinated with 15 NATO nations to develop a standard interface among national tactical systems to form a federated network. This family of standardization agreements will not only improve network capability among the United States, the NATO Response Force, and coalition forces, but will also increase interoperability by improving reliability, connectivity, redundancy, and traffic flow. Cesare Balducci, Deputy Director of the NATO Standardization Agency, once said "there's no capability without interoperability," and this accomplishment demonstrates that fact.

Gregory E. Saunders
Director
Defense Standardization Program Office

Other standardization success stories also were showcased at this year's awards ceremony. Examples include two Army teams. A joint team led by the Army that reinstated the standard for ensuring proper packaging for palletized loads, and another made up of individuals from the Army Research Lab that developed a materials deposition technique for the reclamation of parts. Two Navy teams were also recognized at this year's awards ceremony, one for creating a Virtual Tactical Bridge to improve communications in various training environments, and the other, a joint team led by the Navy, for creating a common reporting system for reporting and investigating aviation deficiencies. An Air Force team was recognized for developing a standard for soft and hard body armor testing. We also recognized an individual from the Defense Supply Center Columbus who developed alternative finishes for high-reliability electrical connectors in lieu of traditional finishes that rely on cadmium, a hazardous chemical, and an individual from the Defense Information Systems Agency who led the effort to carry out a mandate to ensure maintenance of DoD-wide product interoperability through the use of Internet Protocol Version 6.

Our warfighters will probably never know those responsible for these achievements, but they *will* realize that they have been fully supported when on the front lines: the equipment they have been given works properly, interoperates as it is supposed to, and allows them to accomplish their missions accurately, efficiently, and safely.

The standardization community plays an integral part in keeping our men and women in uniform safe and in providing them the tools they need to get the job done. Standards and standardization link common solutions to common problems across all services and frequently across nations. This issue of the *DSP Journal* showcases the accomplishments of the FY08 award winners. I hope that reading about their accomplishments will pique your interest and, perhaps, will even inspire you to submit an award nomination for FY09.

DISA's International Liaison Leads to Birth of New Interface

Award Winner: Tim Sharpe

Tim Sharpe, of the Defense Information Systems Agency (DISA), established and chaired a working group that worked together with 15 NATO nations to develop a standard interface between national tactical systems to form a federated network. This NATO tactical communications (TACOMS) standardization effort has resulted in a family of standardization agreements (STANAGs) that specify a standard wideband interface as well as external interfaces. These interfaces will provide standard transport layer services for information; Figure 1 depicts the concept.

The TACOMS standards will significantly improve the NATO network-enabled capability. Moreover, they will be the key enablers between the United States, the NATO Response Force, and coalition forces for enhanced network-centric, effects-based operational capability. U.S. implementation of these standards will not only reduce costs and bandwidth associated with satellite communications (SATCOM), but will increase interoperability by improving reliability, connectivity, redundancy, traffic flow, and robustness, while reducing latency and congestion at multinational tactical network interfaces.

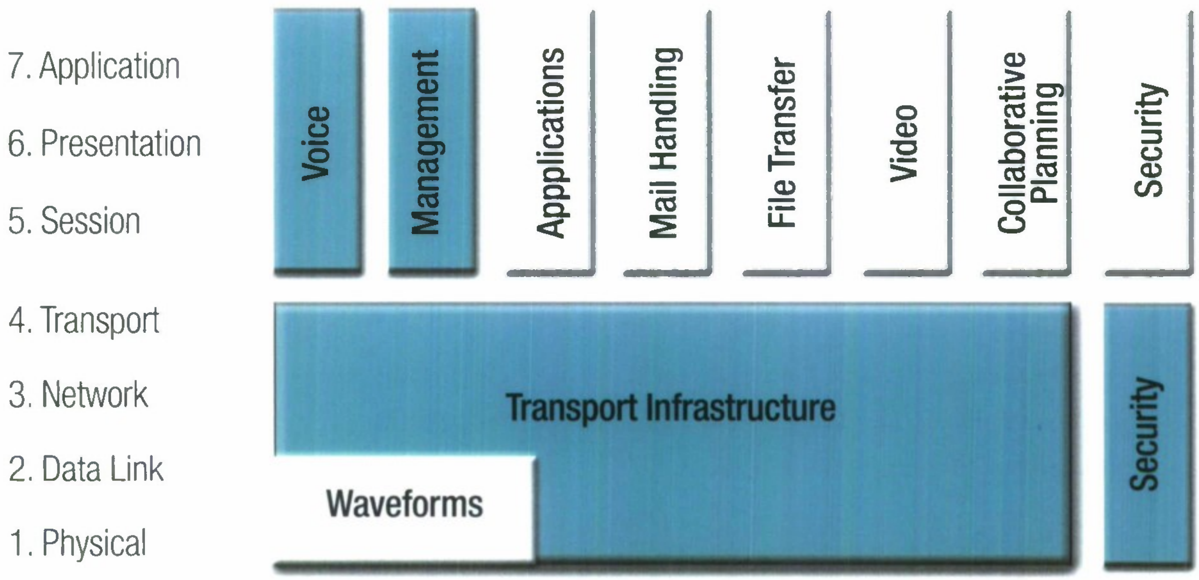
Background

International peacekeeping operations in the Persian Gulf, Somalia, Bosnia, Kosovo, Afghanistan, and Iraq have repeatedly demonstrated that future military operations will be multinational efforts. To best support such efforts, NATO nations realized that they must improve the level of interoperability among their tactical communications systems. Toward that end, 12 NATO nations (subsequently joined by 3 more nations) undertook a project, called TACOMS Post 2000, to form a federated network by developing a standard interface between national tactical systems.

Problem/Opportunity

Current NATO tactical communications systems obtain interoperability primarily via switched communications gateways such as the analog gateway (STANAG 5040) and the digital gateway (the STANAG 4206 series). Due to cost and technical limitations, the interoperability provided is generally restricted to basic 16 Kb and 32 Kb voice and data services. Legacy gateways are channel based, connection oriented, not scalable, and not Internet Protocol (IP) ready. They are therefore not adequate for operational communications traffic and do not provide the degree of interoperability required to exercise command and control on a fluid, fast-changing battlefield. At the International Armed Forces Communications and Electronics Association Symposium held in Paris in February 2005, Brig. Gen. M. Ludwigs (Germany)—the national vice chairman of the Board of Directors for the NATO

FIGURE 1. The TACOMS Concept



Consultation, Command and Control Agency—said, "In today's operations, the front line has been replaced by a 360-degree battle space." Information superiority and network-enabled capability are essential elements for the agile forces necessary to execute coalition operations.

Approach

The TACOMS Post 2000 project began in the former NATO Tri-Service Group on Communications and Electronics. The original 12 participating nations were Belgium, Canada, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Turkey, the United Kingdom, and the United States. Subsequently, Denmark, Finland, and Sweden joined the project. The nations agreed to cooperate and bring together the resources needed for the development effort.

The effort began with the identification of operational requirements and available technologies. This information was the basis for developing system architectures capable of supporting future NATO interoperability requirements. In a parallel effort, the participating nations developed and signed a memorandum of understanding that would become the framework for developing a family of STANAGs that specify standard interfaces between multinational tactical networks.

Mr. Sharpe spearheaded efforts to involve the Joint Users Interoperability Communications Exercise, held in New Jersey, in testing the TACOMS standards. He also engaged nations involved in developing the TACOMS standards to participate

in the exercise to validate the TACOMS interoperability points. The testing concepts laid out by Mr. Sharpe proved to be extremely successful. Subsequently, a codified testing program, based on Mr. Sharpe's testing concepts and known as the Collaborative Implementation Team, was established. This operational testing team continues to evaluate the TACOMS standards at the Command and Control Support Center in the Netherlands, with 10 nations participating. The team has developed many change proposals, implementation guidance papers, and other useful documents.

In addition, Mr. Sharpe fostered U.S. and DoD testing of the TACOMS standards. Specifically, he convinced the Warfighter Information Network–Tactical (WIN-T) program to test the prototype Joint Gateway Node during a DoD Interoperability Communications Exercise. The Joint Gateway Node successfully passed voice, video, and data among six combined/coalition nations.

Developing a consensus-based, technically sound security solution for the standards was another important component of the TACOMS Post 2000 project. Mr. Sharpe led a technical working group to complete Phase 1 of the security architecture, which is key to successful ratification and implementation of the STANAGs. The group incorporated the security architecture into the STANAGs.

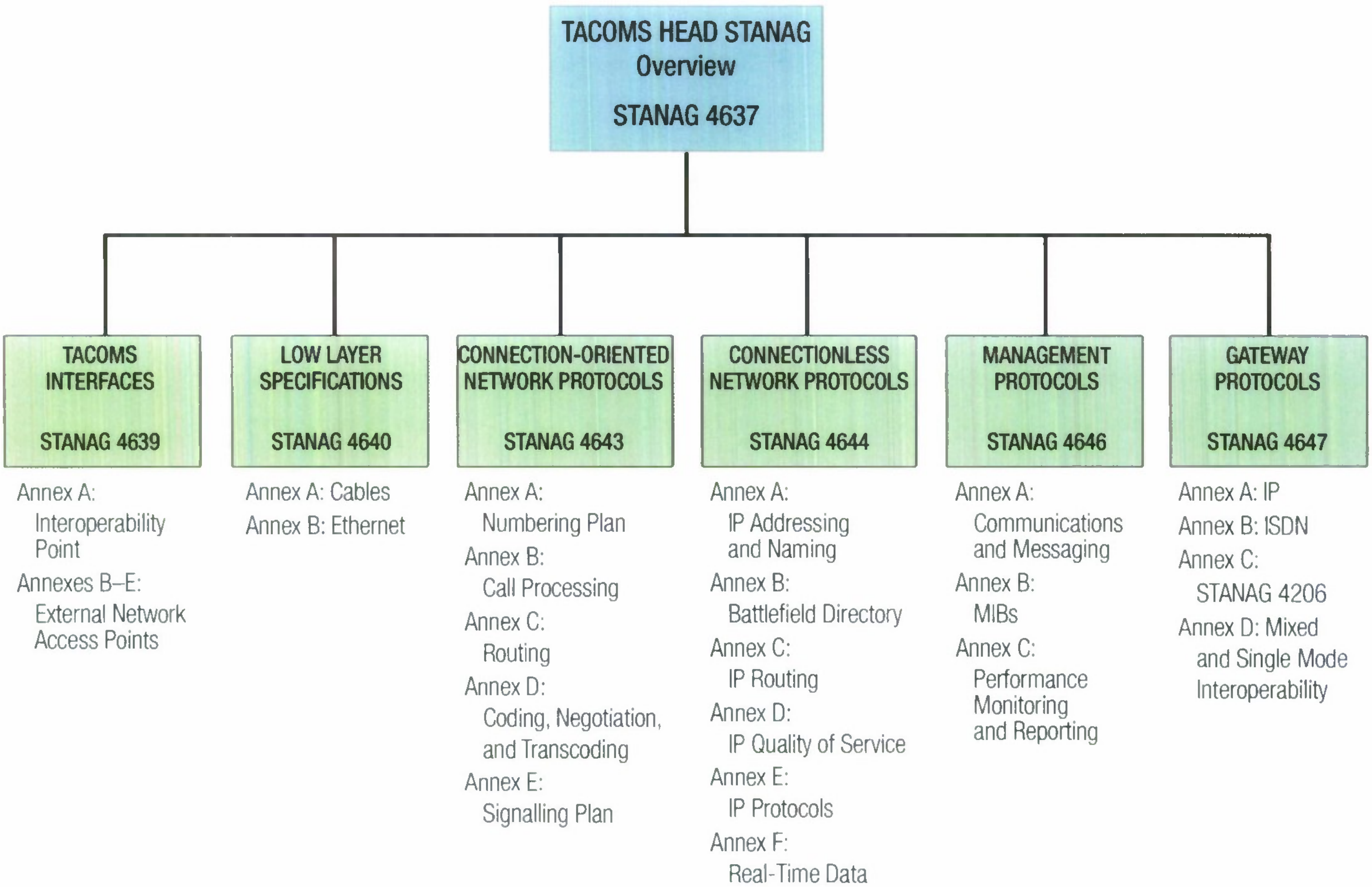
Draft STANAGs were provided to the appropriate NATO groups in late 2008 for entry into the ratification process.

Outcome

The TACOMS Post 2000 project developed a family of STANAGs, as shown in Figure 2. The STANAGs specify a standard wideband interface between multinational tactical networks; the interface, called an interoperability point, is a high-bandwidth IP connection over fiber-optic cable, using commercial protocols wherever possible. The TACOMS STANAGs also describe an external network access point for interfacing with low- and high-threat commercial and legacy tactical networks. The interfaces will provide standard transport layer services (Layers 1 through 4)—including naming, addressing, directory services, quality of service, and security—which are necessary for providing user services (Layers 5 through 7). Not all of the STANAGS were needed to complete Phase 1.

The TACOMS network architecture is service oriented, and the standards include service-level specifications and service-level agreements, including service definitions and parameters. Because the TACOMS architecture is technology independent, nations are free to field tactical communication systems with the technology of their choice as long as they follow TACOMS STANAGs at the interoperability points to meet mini-

FIGURE 2. Structure of the TACOMS STANAGs



mum performance requirements. Nations also are free to implement different generations of switching and transmission technologies, ranging from the current line-of-sight radio relays to the most modern satellite and unmanned-aerial-vehicle-based systems and from Asynchronous Transfer Mode (ATM) systems to IPv6 systems. This independence from a specific technology also enables an evolutionary growth of TACOMS to new standards. Connection to non-TACOMS networks is provided by an Integrated Services Data Network (ISDN) or other external interfaces.

Functions that provide interoperability between national networks based on different technologies, such as ATM, IPv6, ISDN, or other protocols, are a concern of the individual nations. The closer the national technology is to civilian protocols, the easier it is to implement these networking functions.

Security involves functional domains, with separation of duties to satisfy the security principle of least privilege. The most critical functions are connectionless routing service, directory service, call-handling service, and connection-oriented routing service. End-to-end secure voice will be provided by NATO Secure Communications Interoperabil-

ity Protocol, which requires, among other things, a common naming and addressing structure and common directory services.

The standard interfaces will significantly improve NATO network-enabled capability and will be the key enablers between the United States, the NATO Response Force, and coalition forces for enhanced network-centric, effects-based, operational capability. Specifically, the interfaces will increase bandwidth, reliability, redundancy, robustness, and traffic flow, while reducing jitter, latency, delays, outages, and other poor performance. High bandwidth and an interoperable communications infrastructure are the two key enablers that will provide NATO and coalition forces with the network-enabled capability to translate high-speed data into real-time information. These key enablers will result in increased combat power and mission effectiveness in the 360-degree battlespace, increasing situational awareness and reducing fratricide.

Implementation of the TACOMS standards also will reduce costs and bandwidth associated with SATCOM. A DISA simulation cost study of the effect on U.S. SATCOM requirements supporting a deployed Joint Task Force headquarters found a 20 percent reduction in SATCOM traffic volume when lateral links were available. Coalition TACOMS interfaces between the multinational networks are expected to bring even greater SATCOM reductions for the Central Command Regional Information Exchange System, which is a system of gateways and isolated networks provided for various coalition operations traffic. Given the huge costs of launching and operating satellites, a reduction of 20 percent is significant; it equates to hundreds of millions of dollars. In addition to the large cost savings, performance would increase significantly.

Current Status

TACOMS has become the pilot project for a NATO network-enabled capability. Partner nations such as Canada and the Netherlands are fielding a TACOMS Interface Gateway Box, and the U.S. Army Battle Command System is developing a U.S. prototype Interface Gateway Box to share multilateral interoperability command and control data with Canada and the Netherlands.

Several (8 to 10) of the nations have been participating in biannual testing to validate the standards, cooperate on implementation, and display the results at Operation Combined Endeavour.

Both the U.S. European Command and the U.S. Joint Forces Command are reviewing the Joint Concepts Technology Demonstration for possible sponsorship and implementa-

tion of the TACOMS standards. In addition, the Coalition Warfare Program is considering funding the developmental testing described in the Joint Concepts Technology Demonstration, and the WIN-T program plans to implement a TACOMS interface for data with a STANAG 4578 ISDN interface for voice.

Challenges

The primary challenge in developing the family of TACOMS STANAGs was maintaining momentum in a NATO/coalition partnership to resolve technical issues and complete the effort.

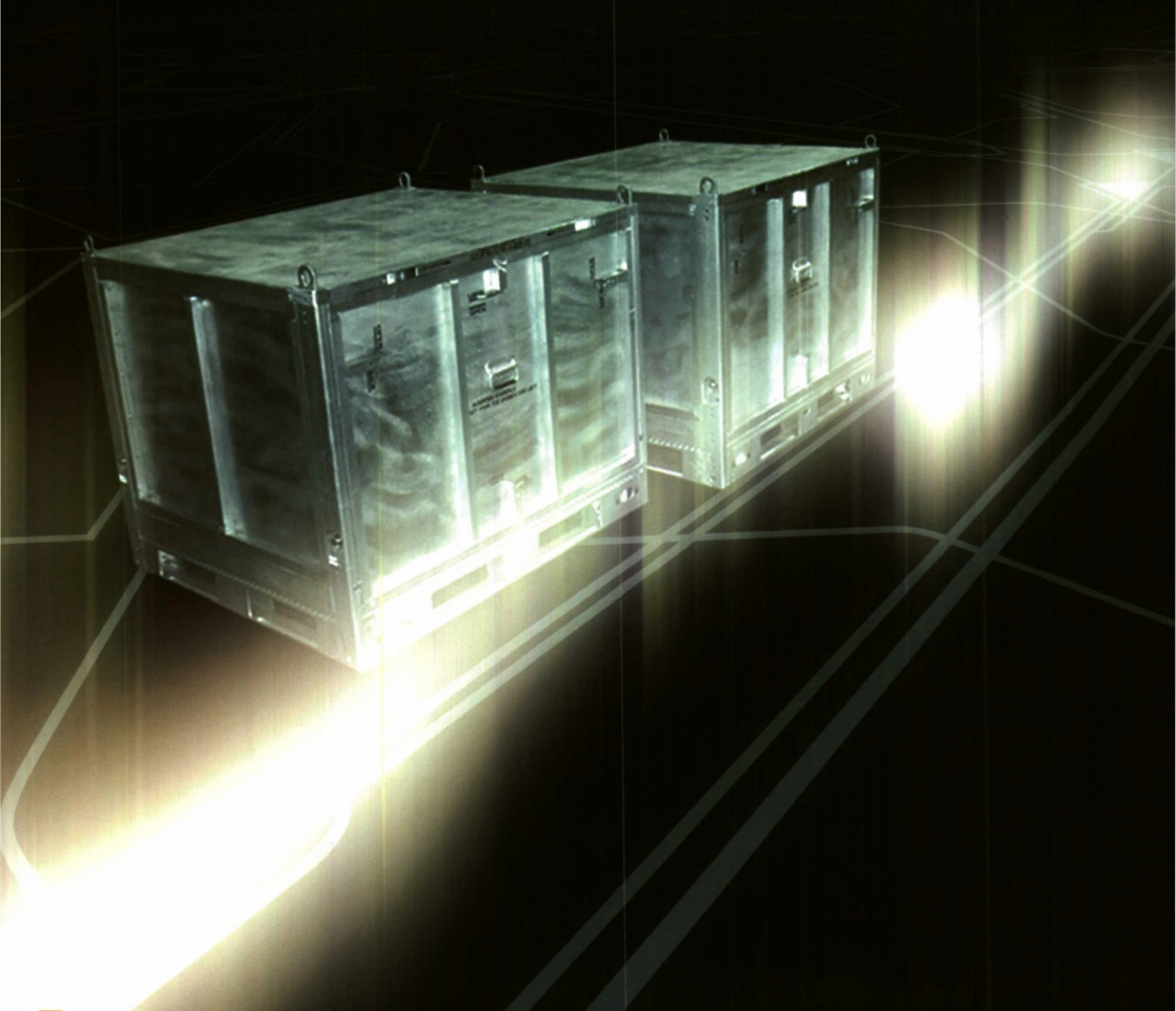
A major barrier to developing, gaining approval for, and implementing TACOMS interoperability standards was the considerable time required to generate and maintain interest in DoD organizations that would potentially implement the standards. Those organizations include the Multi-National Information Sharing Program Office, National Security Agency, DISA Information Assurance Office, Joint Forces Command, U.S. Army WIN-T Program Office, and others. Mr. Sharpe's efforts were essential in overcoming that barrier. As the U.S. focal point for enumerating the value added and the return on investment of the TACOMS Post 2000 effort, he positioned the project to compete for limited resources against numerous other DoD programs focused on command, control, computing, communication, and intelligence equipment. Furthermore, he adeptly coordinated U.S. positions on multiple technical issues related to service and agency network interfaces. Coordinating interoperability among DoD components is a difficult process, as is reaching standard interoperability solutions in a multinational arena, with multiple language, cultural, and other barriers to building trustful relationships and fostering effective cooperation.

About the Award Winner

Tim Sharpe was the driving force essential to the development of the family of NATO STANAGs on interoperable tactical communications. Furthermore, his leadership and his technical and operational expertise were instrumental in linking the standardization effort with prototyping and testing efforts to ensure interoperability, as well as in resolving complex architectural and security issues. In particular, Mr. Sharpe established and chaired the technical working group that produced the TACOMS security architecture. In addition, he authored numerous technical documents and presentations associated with the standards, international-level memorandums of understanding, and management plans for maintaining a maximum level of effort and participation to ensure that development and testing schedules were met. Mr. Sharpe continues to expand operational testing and near-term implementation of the STANAGs via the Combined Warrior Interoperability Demonstration and the Joint Users Interoperability Communications Exercise.

Team's Solution Is Loads More Palletable

Award Winner: Army/DLA Team



A team with members from the U.S. Army Materiel Command (AMC) Logistics Support Activity (LOGSA) and the Defense Logistics Agency (DLA) led the effort to reinstate MIL-STD-147, "Palletized Unit Loads." This standard addresses the methods, materials, and techniques to be employed in forming palletized unit loads of military supplies that are adaptable to unit loading. During acquisition reform, MIL-STD-147 was converted to MIL-HDBK-774. As a handbook, it could only be cited in contracts for guidance; vendors were no longer required to use specific types of pallets or palletization procedures. As a result, the Defense Distribution Depot Susquehanna, Pennsylvania (DDSP) had to repalletize material at an annual cost of some $4.1 million. An integrated product team (IPT) was formed to address the repalletization issue. Specifically, the team looked at the contractual palletization clauses used by the services and DLA. The IPT found that the use of MIL-HDBK-774 resulted in the creation of a plethora of contract clauses that did not provide for adequate palletization and unitization requirements. When attempting to create standard clauses, the IPT found that many of the clauses they were creating had already existed in MIL-STD-147. Therefore, the IPT recommended reinstatement of the standard. The reinstatement, as MIL-STD-147E, will reduce operating costs by eliminating the labor and equipment utilization required to repalletize unstable loads or loads that lack adequate material protection.

Background

MIL-STD-147 was first published in 1957 to specify the methods, materials, and techniques to be employed in the formation of bonded palletized unit loads of military supplies using a standard, general-purpose, 40- by 48-inch pallet. This pallet is readily adaptable to unit loading. Subsequently, the standard was revised four times; the last revision, MIL-STD-147D, was published in 1988 and validated in 1994. During that period of time, no stakeholder problems emerged.

In March 1996, during acquisition reform, DoD decided to cancel MIL-STD-147 and convert the standard into a military handbook. For administrative expediency, the only physical change from MIL-STD-147D was the cover page indicating that the document was now MIL-HDBK-774. Under its new designation as a handbook, the document would be used for "guidance" only and could no longer be cited as a requirement for procurement purposes. This resulted in the use of differing palletization schemes and packaging techniques to deliver materials to DoD. Improperly palletized loads could not be accommodated in DoD's automated materials-handling systems.

Problem/Opportunity

At the June 2005 meeting of the Defense Packaging Policy Group (DPPG)—a joint service committee with representatives from the Army, Air Force, Navy, Marine Corps, DLA, and Defense Contract Management Agency, plus nonvoting representatives from

the U.S. Transportation Command and School of Military Packaging Technology—stakeholders raised issues concerning the lack of standards for palletized unit loads. For example, because vendors were not required to use standard-size pallets or palletization procedures, DLA depots were required to repalletize supplies before they could be handled and stored in DLA's distribution system or distributed to military units. At DDSP, the largest DoD wholesale distribution depot in the United States, the cost of repalletizing material was about $4.1 million annually.

Approach

To address the repalletization problem, the DPPG established an IPT to be led by DLA. DPPG directed the IPT to look at the palletization-related contractual clauses used by the services and DLA with the objective of developing a standard palletization contract clause to be used by DoD acquisition activities, with other specific requirements tailored to the commodity or item.

The preparing activity (PA) and Army custodian for the standard—LOGSA's Packaging, Storage, and Containerization Center (PSCC)—tested the likelihood of the proposal's acceptance by coordinating with the DoD standardization community and industry groups.

DLA reported the IPT's findings at the January 2006 DPPG meeting. Specifically, the IPT found a plethora of contract clauses that did not provide adequate palletization and unitization requirements. The IPT also found that each buying activity had created its own version of a palletization contract clause, which exacerbated the situation. When attempting to create a standard clause, the IPT found that the document they were creating had existed as MIL-STD-147. Therefore, the IPT recommended reinstating MIL-STD-147, noting that it was well organized and made it easy to locate the commodities or types of items palletized.

The Preparing Activity (PA) and Army custodian for the standard—LOGSA's Packaging, Storage, and Containerization Center (PSCC)—tested the likelihood of the proposal's acceptance by coordinating with the DoD standardization community and industry groups. The proposal received a positive endorsement. The key to industry acceptance was to explain the legitimate business reasons for reinstating the standard. The following were among the entities informed of the proposed reinstatement:

- National Institute for Packaging, Handling and Logistics Engineers (NIPHLE). NIPHLE is an international association of professionals with technical expertise in

the complex and diverse practices of packaging, distribution, and logistics. Members represent a wide spectrum of industry that is responsible for preparing products for shipment, storage, and distribution.

- American National Standards Institute MH1 and MH10 standards committees.
- Virginia Polytechnic Institute and State University.
- Various vendors.

In August 2006, considering the unanimous support from the preliminary coordination and survey of industry groups, standardization organizations, and academia, as well as of service and DLA custodians, DPPG formally petitioned the PA to initiate the reinstatement process. Subsequently, the PA endorsed the DPPG petition and recommended approval to the Army Departmental Standardization Office (DepSO) at AMC headquarters. The Army DepSO requested the collection, evaluation, and validation of more DLA data to ensure that the proposal was a sound business decision and was indeed logical.

In March 2007, the Army Standardization Executive (SE) approved continuing the conversion of MIL-HDBK-774 back to a military standard, with the provision that the military standard would be updated and that the other service SEs would be canvassed prior to a final approval decision. The Army SE also directed the PA to obtain responses from the service custodians (Navy, Air Force, and DLA) and include the service SEs' positions on the conversion.

During the conversion process, the PA followed the requirements of DoD 4120.24-M, "DoD Standardization Program (DSP) Policies and Procedures," for the reinstatement of military standards. The PA updated and revised the document to ensure that the latest procedures and advancements in technology were incorporated in the published document. The PA coordinated two drafts—one in June 2007 and the other in September 2007—with the standardization community, DoD subject matter experts (SMEs), and industry. The results of the coordination were provided to the Army DepSO.

In April 2008, the PA presented a final package, including the finalized draft and the custodian and SE concurrences from the other services, to the Army SE for review. The Army SE decided to approve the military standard. The PA submitted the final document to the Document Automation and Production Service for inclusion in the Acquisition Streamlining and Standardization Information System (ASSIST) database. MIL-HDBK-774 was reissued as MIL-STD-147E in May 2008. In addition, MIL-STD-147E is listed as a U.S. national implementation document for NATO standardization agreement (STANAG) 2828, Edition 6, "Military Pallets, Packages and Containers."

Outcome

Converting MIL-HDBK-774 back to MIL-STD-147 has several tangible and intangible benefits:

- *Cost avoidance.* Operating costs and man-hours required to repalletize unstable loads or loads with inadequate protection are reduced. In addition, the use of standardized unit loads reduces transit damage and thus decreases frustration for customers receiving the material. For DDSP, the annual cost avoidance is some $4.1 million.
- *Safety.* Stable unit loads reduce the liability of materials handling. In other words, properly packaged material reduces the safety risk for military and civilian employees either working with or near the unit loads.
- *Performance improvement.* Manual handling, repair, and adjustments of unit loads are reduced, which in turn increases productivity and reduces customer wait time. In addition, with the reduction in handling requirements, critical manpower resources can be shifted to higher-priority tasks.
- *Operational improvement.* The standard accommodates current DoD depot and materials-handling systems, enhances materials-handling interoperability, and improves operational processes and storage space utilization. In addition, because DoD controls unitization requirements, DoD distribution operations planning is simplified and can focus on systems and equipment to meet mission requirements and thus enhance military readiness.
- *Interoperability.* A uniform palletization method across DLA depots and DoD enhances materials-handling interoperability amongst the services and with NATO nations.
- *Improved quality.* Materiel loss and damage due to inadequate palletization of unit loads are substantially reduced.
- *Environmental improvement.* The disposal and entry of nonconforming pallets and materials into the waste stream is decreased.
- *Industry competition.* Enhanced communication lines and specific contract requirements between DoD and industry create a level playing field for suppliers and vendors, enabling them to respond competitively to DoD requests for quotations.

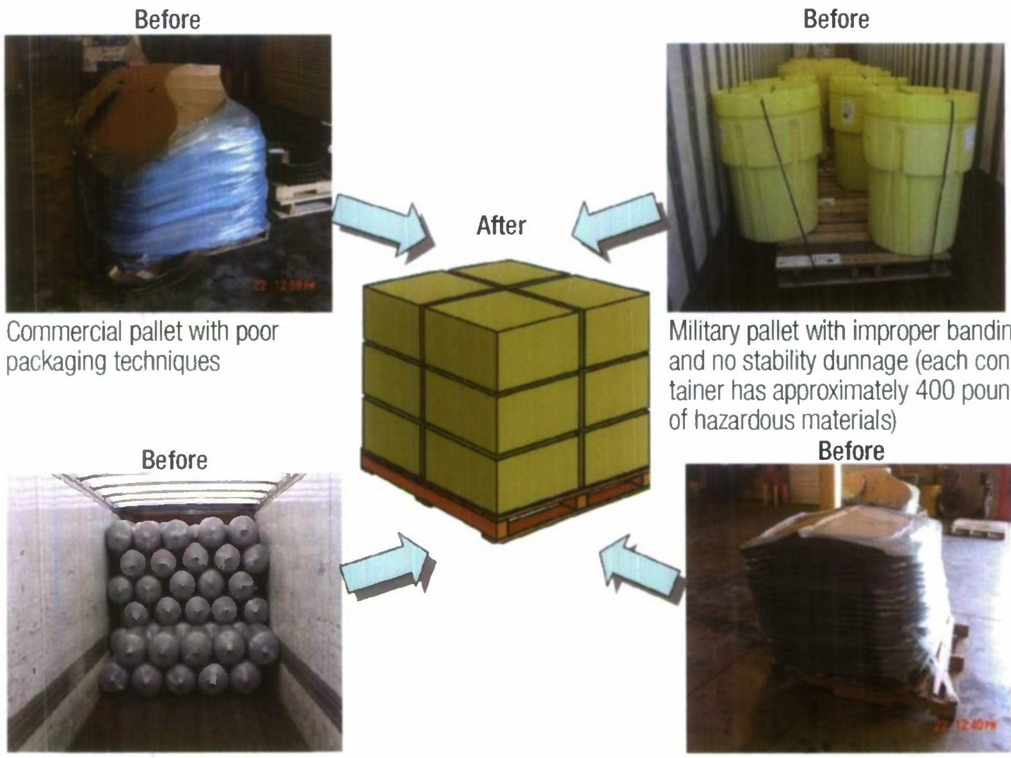
Current Status

MIL-STD-147E was implemented in May 2008. Copies of MIL-STD-147E are available online at http://www.assist.daps.dla.mil. Figure 1 shows examples of palletization before and after reinstatement of the standard.

Challenges

Ensuring that the job was done properly and that the best interests of DoD were served required the following actions:

FIGURE 1. Before and After Reinstatement of MIL-STD-147, "Palletized Unit Loads"



Commercial pallet with poor packaging techniques

Military pallet with improper banding and no stability dunnage (each container has approximately 400 pounds of hazardous materials)

No pallet; individual cylinders must be offloaded manually

Commercial pallet with poor packaging techniques

- The DPPG-sponsored IPT considered alternative approaches and solutions to the conversion.
- The PA and stakeholders overcame significant challenges to demonstrate why the military handbook should be converted back to a military standard.
- Because the process received close scrutiny, a team of DoD stakeholders was established to ensure the conversion was on target and successful.
- To ensure overall DoD support, the service SEs were canvassed for concurrence.
- Where possible, the PA pursued an accelerated coordination process for the revision of MIL-STD-147.
- The PA ensured that the finalized MIL-STD-147E reflected current requirements.

About the Award Winner

The Army/DLA team consisted of Thomas Kozlowski, Kenneth Hill, Timothy Keller, Ann Podrasky, and Joseph Wolak.

Thomas Kozlowski, an industrial engineer at LOGSA PSCC, served as senior action officer, resolving user comments, validating the business justification, and ensuring that the military standard was properly updated. Mr. Kozlowski played a key role in the coordination between AMC headquarters and stakeholder communities, and he prepared papers for higher-level reviews. As U.S. representative to the NATO Combat Service Support Supply Panel and custodian of STANAG 2828,

he incorporated MIL-STD-147E criteria in the STANAG for improving U.S./NATO interoperability on pallet unitization.

Kenneth Hill, the senior packaging specialist at LOGSA PSCC, chaired and served as Army representative to the DPPG. He was instrumental in advancing palletization issues for the DPPG. As DPPG chair, he charged the IPT with writing an all-inclusive DoD palletization clause that could be used in most DoD contracts for the procurement of commodities. He led the unanimous endorsement of DPPG members and petitioned for the MIL-STD-147 conversion. In addition, Mr. Hill led the LOGSA PSCC team of SMEs who updated the technical information in the document.

Timothy Keller, a product specialist at the Defense Supply Center Philadelphia and chair of the Joint Working Group on Pallet Standardization, was the key interface between DPPG and the product manager office. In addition, he chaired the DPPG IPT. Mr. Keller's contacts with professional associations and contract awardees enabled him to coordinate commercial acceptance of the conversion.

Ann Podrasky is a packaging specialist and manages the DSP process at LOGSA PSCC. She was the point of contact on domestic standardization efforts regarding MIL-STD-147. Ms. Podrasky coordinated the drafts of the standard with DoD and industry, obtained the approvals of the various service SEs, incorporated the changes into the standard, and submitted the document for inclusion in the ASSIST database.

Joseph Wolak is a distribution facilities specialist at LOGSA PSCC. He led the domestic standardization team that directly supported the MIL-STD-147E coordination effort with AMC headquarters. In addition, Mr. Wolak obtained program approval to continue the conversion project to completion.

Team Gives Army a Supersonic Cold Spray

Award Winner: Army Team

Images courtesy ARL–Cold Spray Lab

A U.S. Army team led an international effort to develop a manufacturing process for the supersonic particle deposition process known as "cold spray" and the accompanying manufacturing process standard, MIL-STD-3021, "Materials Deposition, Cold Spray." Cold spray will allow for the reclamation of parts during overhaul and repair and a substantial reduction in costs. For example, over a 12-month period, the overhaul and repair of UH-60 Black Hawk main transmission and tail rotor gearbox housing assemblies by Sikorsky Aircraft Corporation cost more than $3 million per year, and other magnesium housings cost about $8 million per year. An estimated 75 percent of these costs can be avoided by using cold spray to reclaim parts. The use of cold spray during the overhaul and repair of all aircraft is expected to result in the reclamation of high-dollar-value parts and cost avoidance of millions of dollars.

Background

Cold spray is an emerging technology that was introduced into the United States by Russian scientists who left their country during the collapse of the Soviet Union. This technology is a materials deposition technique by which particles of metals, nonmetals, or both, propelled by a high-velocity jet of gas, are used to build up a coating or a free-standing structure by means of ballistic impingement upon a substrate. The coatings have very little porosity, few oxides, and high bond strength. Cold spray has many advantages over conventional thermal spray coating technologies in terms of applications, safety, cost, ease of use, process equipment requirements, and operating parameters.

To exploit this technology, the U.S. Army Research Laboratory (ARL) became the focal point for research and development (R&D) of cold spray applications for DoD. ARL quickly identified a variety of potential applications for cold spray. Once the concept of cold spray was studied and its potential as an enabling technology realized, ARL's Weapons and Materials Research Directorate (WMRD) started a program to design, fabricate, and acquire equipment to establish in-house capability for cold spray R&D. The team now has the most well-equipped cold spray facility in the world and has seven systems, including some for prototyping and for use in the field. Both types of systems can be adapted for production. The team developed the expertise and has established collaborative programs with more than 50 industrial partners and various organizations to investigate applications of cold spray.

ARL has shown that cold spray can provide a viable solution to many coating problems. An example of a key application of the cold spray process is the reclamation of costly aircraft parts during overhaul and repair. This application of cold spray has already been successful at the Naval Aviation Depot at Cherry Point, NC (NADEP-CP). Cold spray also can be used in the development of unique materials

and for the production of actual parts. For its work on cold spray, ARL received the prestigious Defense Manufacturing Award and a U.S. Army R&D Achievement Award for 2007.

Problem/Opportunity

The market for cold spray is large because it eliminates many of the inherent deficiencies of traditional thermal spray coating technologies and powder metallurgy (consolidation) techniques. Among the most widely used thermal coating methods are high-velocity oxy-fuel, plasma spray, flame spray, and thermal arc spray. Traditional consolidation methods include high-pressure powder compaction processes in combination with sintering.

Although the traditional methods have been used successfully to produce a variety of materials and coatings to improve wear performance, provide thermal barriers for high-temperature applications, and decrease corrosion damage, they have some problems. Many of the problems associated with these methods arise because of the high temperatures required to heat the material to its melting temperature. With regard to coatings, materials where phase transformations, excessive oxidation, evaporation, or crystallization are possible may not be successfully coated. Additional problems often arise from the residual stresses and deformation induced by the thermal coefficient of expansion mismatch that develops as the coating and substrate cool after deposition. Even if the coating remains bonded to the substrate, the residual stresses may cause unacceptable distortions, significantly weaken the bond strength, or accelerate fatigue failures.

Cold spray overcomes these difficulties, providing superior performance both as a coating and for material consolidation. Consequently, the process has gained wide interest and support in DoD, industry, and academia. Recognizing the large market potential for this process, ARL decided to establish a standardized method for determining various parameters and process requirements. Establishing a standardized method would preclude the development of multiple cold spray processes by multiple entities in DoD and industry.

Approach

The ARL Specifications and Standards Office (S&SO) took on the task of writing and publishing the cold spray standard—MIL-STD-3021. ARL S&SO prepared an outline of a draft standard, and ARL developed a list of potential U.S. and international users and reviewers, in addition to the normal standardization offices for metal finishes and finishing processes and procedures.

After the initial draft that was prepared in-house and after numerous reviews and discussions, the document was coordinated in August 2007 to more than 70 organizations and individuals. The Army team reviewed and discussed the responses, and either incorporated them into a new draft or eliminated them. The new draft was presented at the October 2007 International Cold Spray Conference, held in Akron, OH; 170 participants from 15 countries attended. The team sent out a second coordination draft in November 2007 to more than 35 organizations and individuals. The document was also listed on the ARL Center for Cold Spray website and could be downloaded as an Adobe PDF file. During the coordination of the draft standard, the team received many comments and questions about the process and the manufacturing process standard.

The final draft was briefed at the March 2008 meeting of Environmental Security Technology Certification Program stakeholders. The team requested the stakeholders' review and concurrence. After receiving that concurrence, the team sent the document (MIL-STD-3021) to the WMRD director, who endorsed the document in April 2008. MIL-STD-3021 was then sent to the Army Standardization Executive for approval, which occurred in August 2008. The standard, published on August 4, 2008, is available from the ASSIST Online Database at http://assist.daps.dla.mil/.

Numerous organizations supported this effort, including components of the Army, Navy, and Air Force, as well as U.S. and international entities from industry and academia.

Outcome

Studies conducted by ARL, NADEP-CP, Sikorsky Aircraft, and the Defense Science and Technology Organization (part of Australia's Department of Defense) show that the Army will avoid millions of dollars in costs by using cold spray to reclaim parts during overhaul and repair, rather than purchasing new parts. The potential for significant cost avoidance can be illustrated by an example. The cost of overhauling and repairing the UH-60 main transmission and tail rotor gearbox housing assemblies is about $3 million per year, and the cost of replacing other magnesium housings is approximately $8 million per year. An estimated 75 percent of these costs can be avoided by reclaiming the parts using the cold spray process. This process has significant potential for use in all magnesium components needing buildup and corrosion protection.

Cold spray has also been used to produce a new class of materials that could not be achieved by conventional ingot metallurgy. The cold spray process represents leading-edge technology and provides superior performance over conventional technologies. MIL-STD-3021 enables the government to incorporate cold spray into the technical data package for new system design, as well as for the reclamation of unserviceable parts, such as those in the Army Storage, Analysis, Failure Evaluation, and Reclamation Program.

Examples of Defense and Commercial Entities Interested in Cold Spray

U.S. Army organizations

- Army Aviation and Missile Command
- Army Program Executive Office Aviation
- Corpus Christi Army Depot
- Electromagnetic Gun Program
- Fort Hood

U.S. Navy organizations

- Naval Aviation Depot–Cherry Point
- Naval Research Laboratory
- Office of Naval Research

Other defense organizations

- Defense Advanced Research Projects Agency
- Defense Science and Technology Organization (part of Australia's Department of Defense)
- Joint Strike Fighter Program

Commercial entities

- Allison Transmission, Inc.
- ASB Industries, Inc.
- Boeing Helicopters
- Delphi Corporation
- Ford Motor Company
- Kuchera Defense Systems
- Sikorsky Aircraft Corporation

Current Status

Although cold spray is a new process, and commercial system equipment has only recently become available, several companies, such as Kuchera Defense Systems, have already acquired cold spray capability. More commercial facilities, as well as DoD facilities (such as Fort Hood, Corpus Christi Army Depot, and NADEP-CP), will acquire this capability in FY09. Therefore, the 2008 implementation of MIL-STD-3021 was timely. The standard will direct the maturation of the technology and result in the availability of a better, more reliable product for some applications.

The following are examples of some cold spray applications:

- *Restoration of UH-60 magnesium transmission gearboxes.* Conventional methods (high-velocity oxy-fuel and plasma spray) cannot be used to restore the magnesium transmission gearboxes of the Sikorsky UH-60 Black Hawk, some of which cost $1.2 million each. NADEP-CP is implementing cold spray and expects cost savings of approximately $8 million per year.
- *Surfacing of rails for electromagnetic (EM) rail guns.* Rail contact surfaces must be hard and wear resistant, and they must have adequate electrical conductivity. Refractory metals have good hardness, but poor electrical conductivity. Good conductors, such as copper and aluminum, have poor wear resistance. Composites of refractory metals and

copper can result in materials with good wear resistance and good electrical conductivity. Cold spray is uniquely suited for the deposition of coatings onto temperature-sensitive substrates such as aluminum, and the resulting coating is free of oxides and in a state of residual compressive stress. The use of cold spray for the deposition of such composite materials onto rail surfaces has been demonstrated to be effective. According to the EM Gun program manager, cold spray is "a major breakthrough technology for the future implementation of the EM Gun as a viable weapons system for the DoD." No coating to date has surpassed the performance of cold spray.

- *Electronic shielding for the High Mobility Multipurpose Wheeled Vehicle and mobile missile defense systems.* The shielding effectiveness required for military communications/control enclosures is typically 60 dB. The walls of many of these enclosures are of aluminum panels, joined to other aluminum panels by means of adhesives. The seams at these panel joints are a major source of EM leakage. These seams cannot be sealed through bridging by solder, braze, or high-temperature thermal sprays because the required application temperature would degrade the epoxy adhesive. The ARL team showed how the cold spray metal deposition method can be used to quickly produce conductive metal seam coatings that strongly adhere to the aluminum, do not degrade the structure, and provide the required shielding efficiency. This application will have a major impact on our national defense system and on operations in Iraq and Afghanistan.
- *Apache main rotor mast support.* The Program Executive Office Aviation provided ARL with funding to study the use of cold spray technology for the Apache helicopter mast base support. Corrosion and mechanical damage had rendered approximately 80 parts unserviceable, resulting in a system readiness issue at Fort Hood. A repair procedure was developed to remediate the corrosion/mechanical damage by blending/machining damaged areas and rebuilding lost material using cold spray. Cold spray process parameters were developed at ARL, and a demonstration was conducted at DynCorp International in Killeen, TX, in support of the Army Materiel Command and Fort Hood. The demonstration was successful, and the immediate savings totaled some $500,000.

Challenges

The team experienced both funding and schedule challenges. Initially, the biggest problem associated with the development of MIL-STD-3021 was the level of standardization funds. The team requested but did not receive standardization funds in FY07 and FY08. However, due to the need for and importance of this effort, standardization funds were

reprogrammed internally in FY08, so this effort could be finalized. Funding for the ARL S&SO was limited in FY07 to only $138,600, so reprogramming was out of the question. Therefore, funds were acquired from ARL.

The schedule challenges concerned finalization and publication of MIL-STD-3021. Finalization was delayed because the team, recognizing the worldwide applicability of the process, solicited comments from users in Europe, North America, and Asia. Delays were experienced due to language differences and communication difficulties. However, the team overcame the problems, addressing users' concerns as appropriate. Because of this outreach, the team believes that MIL-STD-3021 is applicable to cold spray operations in all countries.

Publication of MIL-STD-3021 was delayed because of the approval process. Specifically, before a document may be published as a standard, it is necessary to obtain the Army Standardization Executive's approval. However, because the standard and the process it describes are relatively new, the delay in publication had no real effect on its implementation; the application of this process is growing daily.

About the Award Winner

The Army team consisted of Richard Squillacioti, Dennis Helfritch, and Victor Champagne, all from ARL's Weapons and Materials Research Directorate.

Richard Squillacioti, leader of the ARL S&SO, had the initial idea to create a manufacturing process standard for the cold spray operation developed at ARL. He formed the team, led the effort to draft the standard, and coordinated several versions of the document with key government and industry stakeholders. Mr. Squillacioti prepared a package to obtain approval at the ARL Senior Executive Service level and prepared the justification package for the Army Standardization Executive's approval.

Dennis Helfritch, a senior scientist at ARL, was responsible for the technical aspects of the document, including the creation of a list of reviewers and potential users. Dr. Helfritch used his engineering expertise to develop the requirements and evaluate technical comments resulting from the coordination. He was involved with the development and setup of the in-house cold spray operation at ARL.

Victor Champagne, leader of the Advanced Materials and Processing Team, was responsible for establishing the in-house cold spray capability at ARL. He developed the process; obtained the funding required to design, fabricate, and set up the equipment; and made the equipment operational. Mr. Champagne also fostered the implementation of the cold spray operation at DoD and numerous government contractors. In addition, he created the ARL Center for Cold Spray, along with a cold spray website, which is accessible from the ARL website.

Team Spans Wide Gap with Virtual Bridge

Award Winner: Navy Team

A Navy team from the Naval Air Warfare Center Training Systems Division in Orlando, FL, has developed a Virtual Tactical Bridge (VTB) that provides a seamless communications architecture for use in various service training environments. Such a bridge was needed because training methods, control mechanisms, system components, and services using disparate live and virtual (simulated) communications devices and protocols based on different standards can lead to unrealistic tactical communications environments. To bridge the gap between live and virtual communications, the VTB team used a flexible, standards-based software application coupled with commercial off-the-shelf (COTS) hardware. The resulting VTB architecture supports a variety of interfaces to both live and virtual radios and will allow the addition of new interfaces as equipment and requirements change. The bridge, which is now being used for training by all of the services, provides a more realistic training environment for warfighters by enabling interoperability among various training systems. In addition, use of the VTB reduces the time required for testing and configuring communications for large-scale distributed training exercises. The VTB can also reduce costs by reducing the labor associated with testing and configuring communications towers, and it reduces maintenance and equipment costs through the use of commercial components.

Background

Large-scale distributed training events, which sometimes include all of the U.S. military services as well as coalition partners, may incorporate thousands of live (radio frequency, line of sight, and satellite) transmissions and virtual, or simulated, transmissions. The live and virtual transmissions may occur either in parallel or serially. Typically, these communications are spread across multiple domains with disparate architectures, simulation systems, and communication systems. Supporting interoperability among multiple live and simulation domains requires using multiple protocols, such as live and simulated transport protocols, control protocols, bridge protocols, and data reduction and storage protocols. The diversity of systems and protocols can lead to information loss.

As the communication domains converge, emerge, and evolve to form a homogeneous simulated battle space, the questions of realism and control emerge. Methods, control mechanisms, system components, and practices that use disparate communication devices and protocols can lead to unrealistic tactical communication environments. The ad hoc connection of varying technologies and protocols, without regard to or characterization of the human involved, can result in ineffective training.

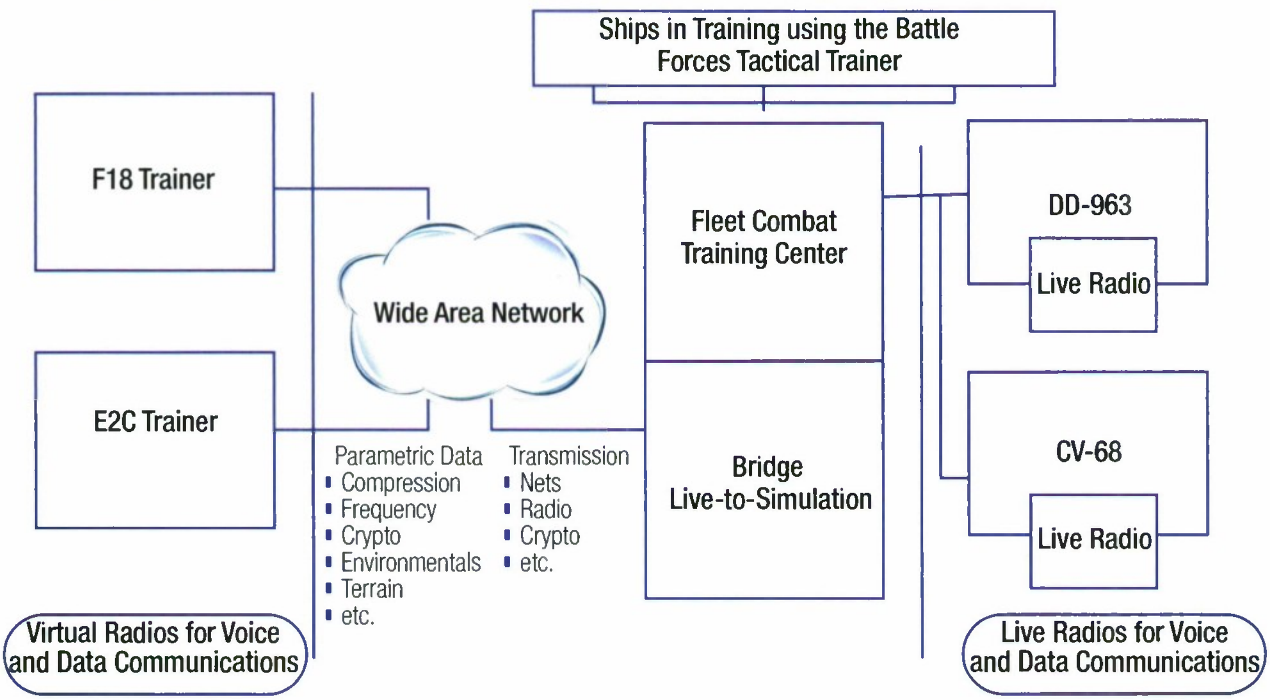
Seamless interoperability among various training systems, communications systems, and simulations is crucial for all major military training systems and is invaluable for tactical training exercises. However, as communication network topologies used in joint training

exercises become increasingly complex, the ability to control, configure, monitor, analyze, and support the training infrastructure becomes increasingly problematic. A standardized bridging architecture would help ensure that exercise parametric data, control, and communications maintain the degree of realism necessary for training events.

Problem/Opportunity

Figure 1 illustrates the challenge of communications in a training environment with both simulation and live components. The virtual trainers for the F18 and E2C are represented on the left side of the figure. The live shipboard equipment (DD-963 and CV-68) is represented on the right side along with other ships in training using the Battle Force Tactical Training system. The live shipboard equipment communicates with a shore-based facility, such as the Fleet Combat Training Center. In order for the virtual trainers on the left to communicate with the live shipboard equipment on the right, the virtual communications must first be sent to a network encryption system and then to the wide area network for distribution to the live training network. Once the communications have reached the switching network, the information is relayed to the appropriate cryptography device or radio that then relays the communications to the ship. Live-to-simulation (or Live-to-SIM) gateways or bridges manage various parametric data and transmission characteristics. Data, including digitized voice, are usually transferred between a live platform and a simulation as packets of data.

FIGURE 1. The Challenge of Virtual and Live Communications in a Complex Training Environment

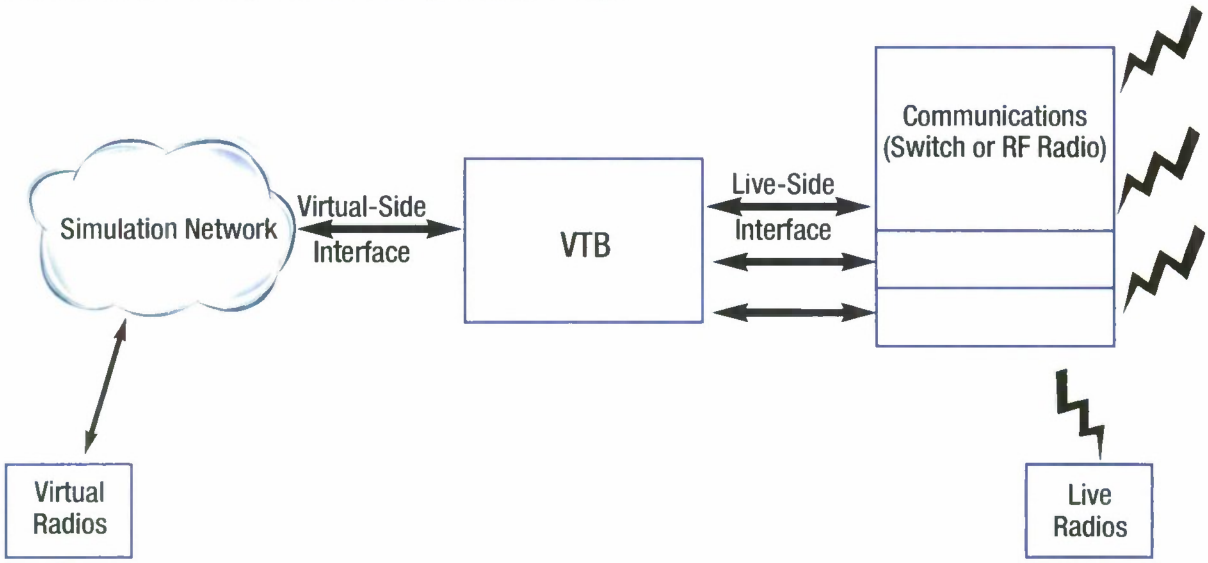


To maximize training effectiveness, virtual communication systems must accommodate a variety of functions. For example, live aviation radios must be able to communicate with simulated components and environments. As another example, personnel in the field must be able to communicate with other personnel in the field, but through a simulation network. These and innumerable other communications during a complex training exercise cannot occur realistically without a virtual communication system capable of bridging the gap between simulation and live systems. Moreover, the system must be able to accommodate emerging technologies to ensure realistic interoperability in the training environment well into the future. A team from the Concept Development and Integration Laboratory at the Naval Air Warfare Center Training Systems Division in Orlando, FL, decided to develop that capability.

Approach

To bridge the gap between virtual and live communications, the Navy team determined that it needed to develop a piece of equipment that can support a variety of interfaces to both virtual and live radios. In addition, the team needed to build the equipment on a flexible and standardized architecture to allow the addition of interfaces as equipment and requirements change. Figure 2 depicts the VTB concept.

FIGURE 2. The Concept for the Virtual Tactical Bridge



The team decided to build the VTB architecture based on the PC-based Marine Corps Digital Voice software application/design—a flexible, standards-based virtual radio core—coupled with COTS PC hardware. The resulting VTB can meet a wide variety of both virtual-side and live-side interface requirements:

- *Virtual-side interfaces.* Virtual-side interfaces typically are Ethernet connections to a distributed computer network. Virtual radio systems reside on this network and send transmitter parameters and digitized audio via a User Datagram Protocol or Transmission Control Protocol/Internet Protocol. The VTB currently supports Institute of Electrical and Electronics Engineers (IEEE) 1278.1, "Distributed Interactive Simulation"; IEEE 1516, "High Level Architecture"; and "Voice over Internet Protocol" (ITU H.323). Audio encoding (voice compression) standards include Mu-Law, pulse-code modulation, continuously variable slope delta modulation, and Global System for Mobile Communication half-rate calls, among others.
- *Live-side interfaces.* Live-side interfaces typically have cables to operational equipment. The VTB currently supports interfaces to communications switching systems and to multiple types of radios (e.g., PRC-117/119, PRC-148, and Harris 5800). Connections to communications switching systems vary with the type of switch. Connections to individual radios are typically via the standard H-250 handset connector. In some cases, the interface includes not only audio in/out and push-to-talk signals, but also control and status information provided by the operational device. Each VTB system can be configured to support up to 16 live-side interface channels simultaneously. Multiple VTB systems can be installed to support any number of simultaneous channels; for instance, two 16-channel VTBs will provide a 32-channel capability.

Outcome

The VTB uses leading-edge communications technologies to integrate many live and virtual communications into a seamless battle-space training environment. The new bridging architecture supports training by the U.S. military services, including Special Operation Forces and Joint Forces, as well as by the Royal Navy and the German Navy.

In addition to providing a realistic training environment, the VTB provides many cost-saving measures, such as the following:

- *Reduction in exercise preparation time.* Typical radio test and configuration time, before VTB technology insertion, was about 7 days. With VTB technology, the preparation time is less than 2 days.
- *Reduction or elimination of travel time.* Testing and configuring radios for a large-scale distributed training exercise typically required personnel to travel to each East Coast re-

transmission tower. The remote control features of VTB technology have largely eliminated this requirement.

- *Reduction in labor costs.* With VTB technologies, tower labor requirements have been reduced.
- *Reduction in maintenance and equipment cost.* Many pieces of higher cost operational equipment have been replaced by VTB COTS components, thus lowering initial tower costs and providing COTS maintenance to the VTB equipment.

Current Status

The Navy has installed VTB systems at all major East Coast ports and, in September 2008, began installing the new systems at the major West Coast ports (including Hawaii and Japan). The Navy Continuous Training Environment is using the systems for Fleet Synthetic Training events. Further enhancements will be implemented in FY09.

The Army has installed VTB systems at the Joint Readiness Training Center (Fort Polk, LA) and the National Training Center (Fort Irwin, CA). Further enhancements will be implemented in FY09.

The Air Force has completed a proof-of-concept installation and demonstration at Eielson Air Force Base, AK. It has used the VTB in both Northern Edge and Homeland Defense training events. A VTB unit has been delivered to the Air Force's Distributed Mission Operations Center, one of the largest simulation facilities in the world, for further evaluation.

The navies of two coalition partners—Germany and the United Kingdom—have installed VTB systems.

Challenges

The need for the capability to integrate the various radio capabilities (both live and virtual) used by the services and coalition partners was well recognized and, therefore, was well supported from both a monetary and political standpoint. The only barrier was technical: how best to integrate various live and virtual radios and communications devices, each using a different standard, into a seamless communications architecture. As an example of the challenge, for Fleet Synthetic Training in the Navy Continuous Training Environment, Navy ships use network telephones using a telephony standard (H.323) for communicating across the network, while the rest of the Navy and the Air Force, Marine Corps, and Army use a modeling and simulation approach based on either IEEE 1278.1 ("Distributed Interactive Simulation") or IEEE 1516 ("High Level Architecture").

About the Award Winner

The Naval Air Warfare Center Training Systems Division, in Orlando, FL, has a long history of developing and delivering state-of-the-art virtual communications architectures and technologies under the leadership of Dave Kotick, chief modeling and simulation engineer. Under his direction, the Navy team consisted of Robert Reif, John Allen, Lance Legan, Chris Sprague, and Peter McCarthy. Their roles on the VTB program were as follows:

- Robert Reif, VTB lead software engineer. Mr. Reif was the lead software developer for the Navy and Marine Corps VTB programs. He also provided VTB installation support to the Navy and Marine Corps.
- John Allen, VTB lead hardware engineer. Mr. Allen also provided hardware installation and test support.
- Lance Legan, computer engineer. Mr. Legan was the lead software developer for the Army and special VTB programs. He also provided installation and test support.
- Chris Sprague, computer engineer. Mr. Sprague was the lead software developer for the Air Force VTB program. In addition, he provided VTB installation and test support to the Air Force.
- Peter McCarthy, computer engineer. Mr. McCarthy was the lead software developer of the VTB virtual interface and radio control lead. He also provided installation and test support.

Joint Deficiency Reporting System Saves Millions

Award Winner: Joint Team

A joint team led by the Navy created a common Joint Deficiency Reporting System (JDRS) throughout the military aviation sector. A Deficiency Report (DR) is a formal notice of problems with specific items or equipment. The team's objective was to provide a single, standardized, interoperable automated system for reporting, investigating, and addressing all aviation-related DRs. Some 50,000 DRs are expected to be processed through JDRS annually. Although the primary goal is to improve equipment reliability, the system also yields substantial financial benefits. JDRS will result in an annual cost avoidance of more than $1 million by eliminating redundancies associated with maintaining separate DR systems, as well as an annual cost avoidance of an estimated $2.6 million by facilitating engineering investigations related to problems with aviation equipment and platforms commonly used by multiple services.

Background

In recent years, the Air Force, Army, Naval Air Systems Command (NAVAIR), and Coast Guard have independently pursued improvements to aviation-related DR policy, training, technology, and processing. Because the military aeronautical community uses a significantly large number of common platforms, systems, subsystems, and component parts that are flight safety and mission critical, it is vital that information on deficiencies and their resolutions are readily shared across the services. The need to seamlessly exchange information on problems across the aeronautical community has become even more important with the prevalence of joint service programs such as the F-35, C-130, H-60, and V-22 and of common mission equipment used in unique programs. In addition, increasing emphasis on aviation-critical safety items and the timely sharing of this information across service lines has been recognized as essential to maintain quality, safety, suitability, and effectiveness of the products that are procured.

Because of the similarity in parts, equipment, weapon systems, and contractors throughout the aviation sector, the Joint Aeronautical Logistics Commanders (JALC) formed a joint team in October 2006 to develop a single, standardized, interoperable automated system for reporting, investigating, and dispositioning all aviation-related DRs. (Various types of DRs relate to whether an issue occurred during test and evaluation; as a result of procurement, production, or rework; during operation; or in technical publications.) The new system, JDRS, was to standardize the DR process and provide visibility of deficiencies and their resolutions across the participating services.

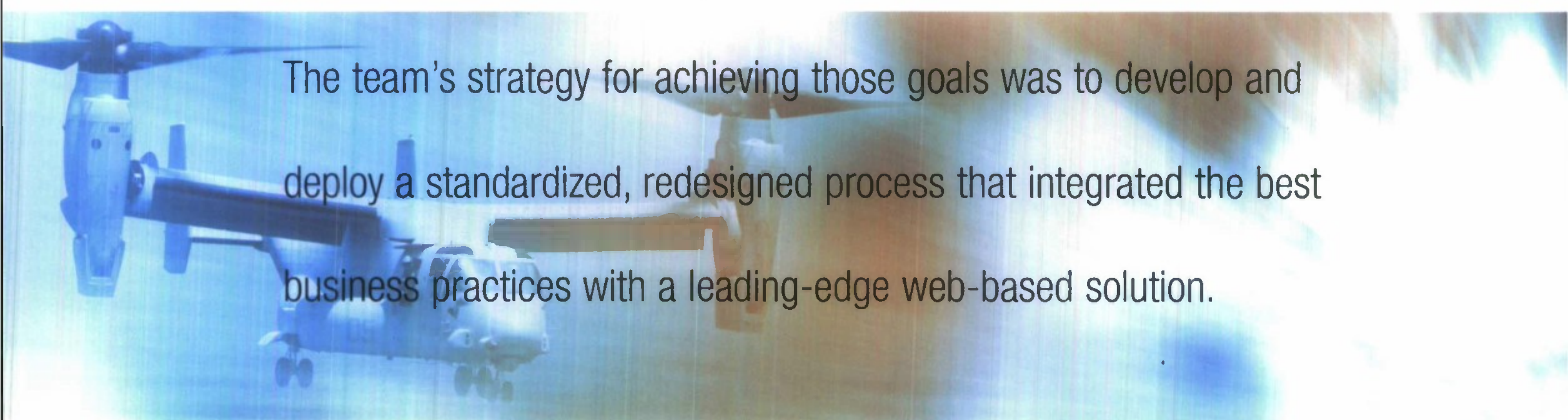
Problem/Opportunity

The functionality of the deficiency reporting applications operated and maintained separately by the Air Force, Army, NAVAIR, and Coast Guard ranged from simple manual tracking systems to modern, workflow-driven, web-based applications. These systems had very limited interoperability, utilizing an interface primarily designed to transfer only se-

lect deficiency data related to only one type of deficiency and only when action was required from another organization. Supplemental and updated information and intermediary process actions were not communicated among systems; instead, keeping up to date required continual manual monitoring by each service's DR representative. Of particular concern was the lack of visibility among the services on deficiencies, investigations, resolutions, and mitigation actions that were processed and documented by one service, but applicable to the other services using the same platform, system, or part.

Approach

The primary goals for JDRS were to improve investigations into aviation-related problems, enhance flight safety, and improve equipment reliability. The team's strategy for achieving those goals was to develop and deploy a standardized, redesigned process that integrated the best business practices with a leading-edge web-based solution. The team based JDRS on NAVAIR's Naval Aviation Maintenance Discrepancy Reporting Program, an application for reporting engineering investigations on products that experienced problems while in use, hazardous material and equipment safety reports, deficient technical publications, and new or recently overhauled equipment with manufacturing defects or substandard workmanship.



The JDRS team standardized the basic deficiency reporting process for all services. It integrated this standardized reporting and problem resolution process into a web-based, workflow-driven application, with a shared relational database. In doing so, the JDRS team was able to harmonize the majority of data reporting requirements and capabilities across services and still maintain select essential service-specific fields and workflow requirements.

Outcome

JDRS accommodates the processing of multiple DR types in a single system with a common, user-friendly "look and feel" across the services, Coast Guard, and Defense Contract Management Agency (DCMA) aeronautical sectors: reports on engineering

investigations, material deficiency reports, hazardous material reports, product quality deficiency reports, aircraft inspection deficiency reports, technical publication deficiency reports, software deficiency reports, and test and evaluation reports. The system's processing functions cover the entire DR life cycle, from initiation through final disposition. Those functions include process workflow, material management and tracking, customizable search and displays, management reports, and processing metrics. In addition, JDRS has a suite of administrative tools for managing users, units, roles, and privileges, and it incorporates enhanced capabilities, decision aids, and ease-of-use features common in highly technical environments.

JDRS provides the military aeronautical community with the following benefits:

- *Improved performance.* All JDRS participants use the same standardized workflow for deficiency reporting, have access to all deficiency information acquired throughout an investigation, and have complete visibility of other service investigation findings to avoid duplication of effort.
- *Improved safety, reliability, and quality.* By working within a standardized workflow process and using the available web tools, each service can more quickly develop risk mitigation strategies and provide accelerated responses to the warfighter regarding critical flight safety issues as well as reported reliability problems. In addition, the quality of the investigation process and responses is improved due to the standardized, structured approach.
- *Improved sustainability.* The use of one deficiency reporting application in lieu of multiple applications reduces system sustainment requirements involving system security changes, hardware maintenance, system improvements, and so on.
- *Improved interoperability.* The use of a common deficiency reporting application dramatically improves visibility and interoperability among services. JDRS provides a seamless workflow, transferring action on a deficiency from one service to another without the need of an interface to transfer data. All process touch points—from the warfighter who originated the DR to each of the service representatives involved with processing and investigating the deficiency—have visibility of all information acquired throughout the process.
- *Cost savings.* Use of a single common application, rather than multiple service-specific applications, provides substantial cost savings due to the elimination of duplicate investigations by the different services and a reduction in system sustainment costs.
    - Duplicate investigations constitute about 2.5 percent of all common-item investigations. Because JDRS facilitates engineering investigations related to problems with aviation equipment and platforms commonly used by multiple services, some 500 duplicate investigations will be avoided each year (a conservative estimate). The resulting annual cost avoidance is an estimated $2.6 million.

- Sustainment costs are reduced by eliminating redundancies associated with maintaining separate DR systems. This will result in an annual cost avoidance of an estimated $1 million.

Current Status

In May 2008, JDRS achieved initial operating capability (IOC) and became the primary tool used by the Air Force, Army aviation and missiles, Navy aviation, and Coast Guard aviation to manage DRs. Between IOC and October 2008 when full operating capability was achieved, more than 12,700 DRs were processed through JDRS. Ultimately, more than 50,000 DRs are expected to be processed annually.

The system currently hosts more than 11,000 users from NAVAIR, Air Force, Army, Coast Guard, and DCMA. Ultimately, the user base is expected to exceed 16,000 users.

JDRS is managed by a Joint Executive Committee, which ensures that the JDRS program will continue to address system improvements for all services in sustainment.

Challenges

The JDRS team faced several challenges:

- *Funding.* When it directed the creation of JDRS, JALC did not provide funding. Instead, each service team was required to "find" the needed revenue, essentially from existing sustainment allocations.
- *Schedule.* JALC challenged the implementation team to reduce the delivery schedule by 4 months.
- *Teaming across multiple services.* The initial JDRS team consisted of members from NAVAIR, the Air Force, and the Army Aviation and Missile Command. Later, the Coast Guard and DCMA joined the JDRS team, adding their requirements to the integration effort.
- *Requirements creep.* Seemingly persistent requirements creep came as the team members developed an understanding of what the basic requirements should be for a common deficiency reporting system and what resources were available (who was responsible for what, from each service).

As a result of significant work and dedicated leadership from each service, a meaningful memorandum of agreement was developed and approved that bound the project's scope, schedule, and resources. Despite the lack of funding, reduced schedule, teaming across multiple services, requirements creep, and other issues, the JDRS team was able to deploy JDRS on schedule, within budget, and with full functionality.

About the Award Winner

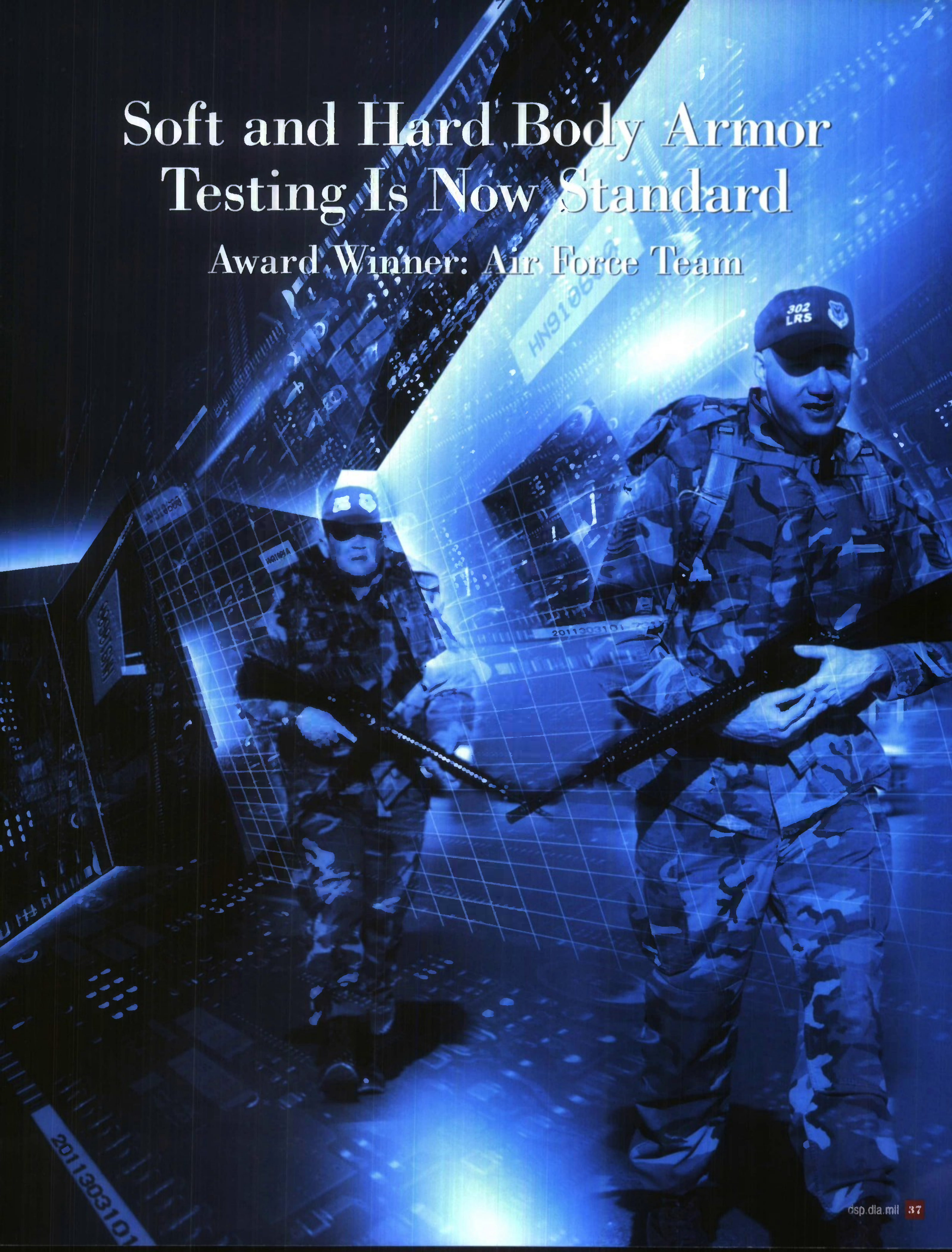
The joint JDRS leadership team consisted of Steven Hauck (NAVAIR), William Queener (Air Force), David Christy (Army Aviation and Missile Command), William Duren (Coast Guard), and William Folsom (DCMA). The team members acted together as the JDRS Executive Committee, ensuring that all facets of the effort were on schedule and all issues were addressed and resolved. They were superbly supported by several other key government and contractor personnel.

Mr. Hauck led the JDRS team. His program management functions for the JDRS effort included coordinating the resource, schedule, and performance agreements with the participating services; coordinating funding; coordinating and establishing system functional design requirements and development priorities; monitoring program milestone status; ensuring DoD program compliance with applicable system certification, accreditation, and IT registration; and briefing the JDRS implementation status monthly to NAVAIR managers and JALC leaders.

Each leadership team member was responsible for the programmatic and coordination efforts related to JDRS planning, resources, and implementation within their respective service. As the JDRS management leads within their respective service, the team members assigned tasks related to actions to be taken by their service and briefed their leaders as appropriate. They also were responsible for all JDRS requirements review/approval, documentation, and testing as it related to their respective service, as well as for coordination of user testing and policy change.

Soft and Hard Body Armor Testing Is Now Standard

Award Winner: Air Force Team



An Air Force team led an effort to coordinate and publish MIL-STD-3027, "Performance Requirements and Testing of Body Armor." This standard provides military-unique requirements for ballistic threat protection, environmental exposure, durability, and testing for use in the development of new soft and hard body armor. Specifically, the standard establishes a new ballistic threat classification scheme and provides body armor manufacturers with standards for performance characteristics and test protocols to support their independent product development and qualification. MIL-STD-3027 enables all the services, whose forces' mission requirements preclude using the Interceptor body armor system, to accurately specify and verify standard military-unique requirements in body armor procurements.

Background

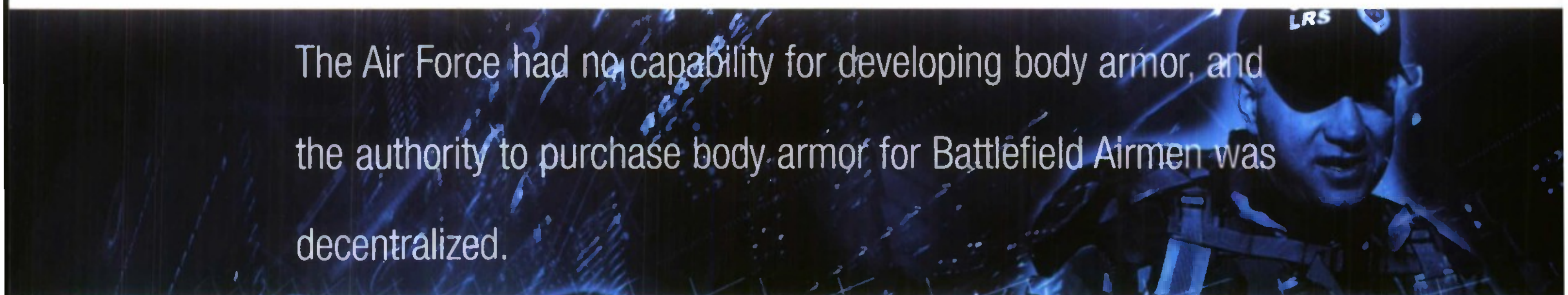
In early 2005, the Air Force began equipping its personnel deploying to Iraq and Afghanistan with the Army-developed Interceptor body armor system consisting of a soft-armor outer tactical vest (OTV) with hard-armor small arms protective insert (SAPI) plates. However, certain Air Force specialties, designated Battlefield Airmen, were exempt from using Interceptor body armor due to its incompatibility with their mission requirements. Instead, they purchased armor from the commercial market. Some Army and Marine Corps personnel were also purchasing their own body armor, due to insufficient quantities of military body armor, as well as issues with the armor's capability against increasing threats.

Only one widely recognized standard was applicable to ballistic performance requirements for body armor: National Institute of Justice (NIJ) Standard 0101.04, "Ballistic Resistance of Personal Body Armor," as amended by NIJ 2005, "Interim Requirements for Bullet-Resistant Body Armor" (both are now superseded by NIJ Standard 0101.06, "Ballistic Resistance of Body Armor," issued in July 2008). Developed for the law enforcement community, the NIJ standard defined requirements consistent with law enforcement's environment and usage. Specifically, the standard identified required ballistic resistance capabilities against handguns and rifles in terms of levels of protection against specific threat rounds, and it identified limited requirements for armor performance after exposure to temperature and humidity, fluid contamination, and certain handling conditions. In addition, the NIJ standard provided for verification of the design performance through testing and certification by a certified laboratory. Once the design was certified, testing of subsequent production lots was not required.

One manufacturer developed a novel hard-armor design, with overlapping ceramic disks for improved coverage and ease of movement, and designated it Dragon Skin. The manufacturer widely advertised Dragon Skin as an NIJ Level III system with better protection and wearability than Army standard Interceptor body armor. In late 2005, the Air

Force Office of Special Investigations (AFOSI), which had special operational requirements, purchased some of the unconventional body armor.

At the time, the Air Force Research Laboratory (AFRL) Materials and Manufacturing Directorate (RX) was researching manufacturing processes for ballistic protection material and, in early 2006, tested a hard armor insert against relevant military threats. The insert experienced failures during the tests. Subsequently, while deployed to Afghanistan in early 2006, the engineer who conducted the AFRL/RX tests recognized that Air Force personnel were arriving in-theater with Dragon Skin and other commercial body armor systems with military threat protection deficiencies. He notified higher-level headquarters of the issues, highlighted some of the requirements differences between the NIJ standard and military SAPI purchase descriptions, and suggested that some Air Force units may lack vital information on purchasing and issuing body armor.



AFRL/RX notified AFOSI of the Dragon Skin test failures, and AFOSI arranged for the Army's Aberdeen Test Center (MD) to conduct qualification testing of its Dragon Skin items to military SAPI requirements. Dragon Skin experienced multiple failures against different threats. A subsequent investigation found the failures to be due to deficient manufacturing quality control. Moreover, the manufacturer was unable to identify the affected lots or serial numbers of the defective armor. Despite these problems, the manufacturer publicly challenged the test results, calling them rigged, and repeatedly asserted its product's superiority to Army standard Interceptor body armor. In response, the Army issued a safety-of-use message prohibiting use of commercial body armor, especially Dragon Skin—an action that resulted in national media coverage, reviews by the DoD Inspector General and Government Accountability Office, and congressional hearings during which questions repeatedly arose regarding the "military standards" for performance and testing.

Problem/Opportunity

Army standard Interceptor body armor was not suitable for use by Air Force Battlefield Airmen. The Air Force had no capability for developing body armor, and the authority to purchase body armor for Battlefield Airmen was decentralized. The NIJ standard for ballistic protection was inadequate for military use, and resulted in DoD acquiring substan-

dard body armor. Military-unique ballistic protection requirements, operational conditions, and repeatable test conditions were documented only in Army specifications, purchase descriptions, and test operations procedures that were not readily visible and available to the other services and industry.

The failure of commercial body armor to meet Army-specific requirements led to unwarranted and prejudicial manufacturer accusations of Army fraud, national media coverage, and high-level DoD and congressional reviews. The Air Force needed to stop procurements of body armor designed to the NIJ standard, and DoD needed a consensus standard for unique military performance and test requirements to enable the procurement of developmental and nondevelopmental body armor.

Approach

Following the initial warning from AFRL/RX noting that Air Force personnel were deploying to Iraq and Afghanistan with deficient armor and that procurement requirements were suspect, the Secretary of the Air Force Engineering and Technical Management Division (SAF/AQRE), also the Air Force Departmental Standardization Office (DepSO), coordinated with Air Force logistics personnel to review Air Force guidance and purchases of body armor. The review identified the mandated use of Interceptor body armor by all but the Battlefield Airmen specialties. A review of past Air Force and Marine Corps body armor procurement documents confirmed the consistent use of NIJ standard levels to describe ballistic protection capability and requirements.

SAF/AQRE worked with AFRL/RX and Army Project Manager Soldier Systems to analyze and compare NIJ Standard 0101.04, as amended by NIJ 2005, against the latest Army purchase descriptions for the Interceptor OTV and SAPI plates. The comparison revealed that the NIJ standard had significantly less stringent ballistic protection, environmental exposure, durability, testing, and quality assurance requirements.

SAF/AQRE worked with Air Force logistics personnel to prepare new procurement guidance for Battlefield Airmen body armor. The plan was to require the review of procurement packages by a technical Office of Primary Responsibility (OPR), since a suitable consensus specification or standard was not available. However, the plan and guidance were not finalized, because no Air Force OPR with appropriate technical personnel was available to do the work.

SAF/AQRE shifted its focus to documenting the military-unique body armor performance and testing requirements. Preliminary discussions were held with NIJ, the National Institute of Standards and Technology (NIST), and the National Law Enforcement and Corrections Technology Center to explore the viability of revising the NIJ standard

to include military requirements. NIJ and NIST understood the need, but rejected the idea due to concerns that the more demanding military performance and testing requirements would drive up the costs of law enforcement body armor. At that point, the strategy shifted to developing a new DoD standard.

In May 2006, SAF/AQRE—in coordination with AFRL/RX, the Aeronautical Systems Center Engineering Standards Office (ASC/ENRS), and DSPO—organized a meeting with equipment, laboratory, test center, and standardization representatives from the Army, Marine Corps, and Defense Logistics Agency (DLA) to address the need, determine support, and establish a plan. The Air Force and Marine Corps representatives supported the need for and use of a defense standard, the Army and DLA representatives agreed to support its development, ASC/ENRS agreed to be the Preparing Activity (PA), and AFRL/RX agreed to be the technical OPR. The selected approach was to consolidate applicable Army purchase descriptions along with the latest test protocols into a testing standard. Characteristics such as size, weight, load-carrying interfaces, and other mission-specific requirements would not be included.

AFRL/RX, with strong support from Army and Marine Corps representatives, gathered the relevant data and worked closely with the PA to develop three preliminary drafts of MIL-STD-3027. A vital and completely new addition to the standard was Appendix A, "Threat Classification," which established a more complete classification scheme for the wider range of military threats compared with the range of law enforcement threats addressed in the NIJ standard. SAF/AQRE and ASC/ENRS created a Body Armor Standard Community of Practice (CoP) collaboration website for all interested parties and used the website to communicate the status of the effort and to post technical information and working drafts.

The PA released the final draft for coordination in July 2008 and received 154 comments from six different individuals and organizations. The PA—with participation by AFRL/RX, SAF/AQRE, ASC's Combat Effectiveness and Vulnerability Analysis Branch (ASC/ENDA), and project members—adjudicated all comments. The ASC Standardization Executive forwarded the final MIL-STD-3027 to the Air Force Standardization Executive, who approved it on September 30, 2008. DLA's Document Automation and Production Service published it without further changes.

Outcome

MIL-STD-3027 establishes a new ballistic threat classification scheme to overcome deficiencies in the NIJ standard related to descriptions of threats relevant to the military environment. The new military standard fills a void in DoD consensus requirements for a critical item of equipment that has been the subject of unfavorable national media atten-

tion, as well as critical reviews by the DoD Inspector General, Government Accountability Office, and Congress. It enables the Air Force and other services, whose forces' mission requirements preclude using the Interceptor body armor system, to accurately specify and verify standard military requirements in body armor procurements. The standard also provides body armor manufacturers, who may want to sell to DoD, with standards for critical performance characteristics and test protocols to support their independent product development and qualification.

Current Status

MIL-STD-3027 is fully released and available in ASSIST. It was distributed within the Air Force to all functional area managers responsible for body armor procurements. It is being incorporated into Air Force procurement guidance as a mandatory standard for specifying, qualifying, and accepting new body armor. MIL-STD-3027's publication also represents a positive DoD response to Section 142 of the FY09 National Defense Appropriations Act, which requires "an assessment of existing initiatives used by the military departments to manage or execute body armor programs." It is also a foundation document for an OSD Director, Operational Test and Evaluation (DOT&E) initiative to develop DoD test standards for personal protective equipment, including body armor and helmets.

Challenges

AFRL/RX mission priorities, technical OPR personnel changes, and major body armor testing issues resulted in a protracted document development period extending from August 2006 through July 2008. The testing issues emerged from the failures of Dragon Skin body armor to meet military requirements and included the inability of existing test protocols to produce repeatable results in different laboratories. High interest by Congress and the DOT&E staff in mid-2007 resulted in Army initiatives to prepare new procedures for testing both soft and hard body armor. These documents changed earlier purchase description test procedures, but were not available for reference to or incorporation in the draft MIL-STD-3027 until July 2008, after the final review draft was released.

ASC's Director of Engineering and Technical Management (ASC/EN) had committed to completing the standard in FY08 and added engineering support from ASC/ENDA to ensure a complete and timely release of the coordination draft, resolution and adjudication of comments, and release of the final document. ASC/EN's support was essential to completing the project.

About the Award Winner

The Air Force team consisted of Todd Turner, Mark Mallory, Timothy Staley, Madeleine Istvan, and Chris Ptachik.

Todd Turner, a materials research engineer at AFRL/RX, researched material and manufacturing processes for improved hard body armor. His tests found Dragon Skin and other commercial armor to be deficient against military threats. Dr. Turner began collaborating with Captain Mallory to identify the root cause: unrecognized differences between military and commercial requirements. Dr. Turner assumed the AFRL/RX technical OPR role and led the development of MIL-STD-3027 through the third and final draft. His effort included a major revision to replace the test protocols from the Interceptor and SAPI purchase descriptions with the newly available test operations procedures, as well as the incorporation and adjudication of final review comments.

Mark Mallory managed a material and manufacturing research project for lighter-weight hard armor plates. He prepared the first Air Force point paper addressing the armor deficiencies identified by Dr. Turner and flagging key differences between military and NIJ requirements. Captain Mallory collaborated with Chris Ptachik on the detailed analysis of Interceptor and SAPI purchase descriptions versus the NIJ standard, and he helped craft the strategy for developing the new standard. He performed the technical OPR role through the first two drafts and was the primary author and interface to the Army participants for obtaining Interceptor/SAPI performance and testing data. Most significantly, Captain Mallory developed the completely new scheme, harmonized with the NIJ standard, for classifying military ballistic threats and protection levels.

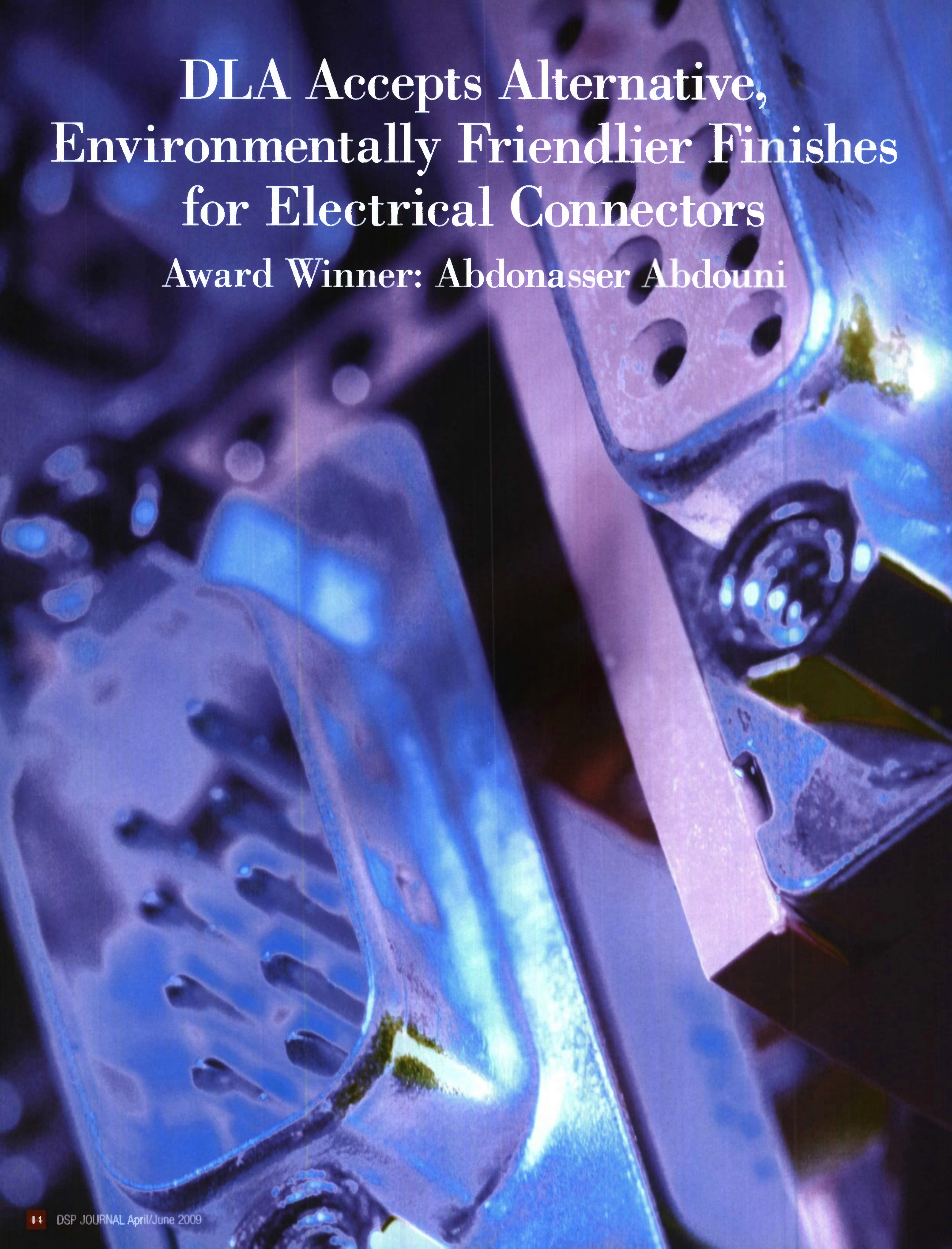
Timothy Staley, an ASC/ENDA vulnerability analyst, was responsible for requirements and analysis of aircraft armor for ballistic threat protection. His work on the final coordination draft was invaluable to integrating requirements from the Interceptor and multiple SAPI purchase descriptions. Mr. Staley reviewed and helped to incorporate and adjudicate comments from the final coordination, and he led the effort to revise the threat classification tables to more thoroughly assign lower-level threats to test threat groups.

Madeleine Istvan, a technical editor at ASC/ENRS, created the standard's template, advised the technical project members on DSP document practices, and posted and maintained source documents on the Body Armor Standard CoP. She edited the drafts of the standard, distributed drafts for review, and consolidated review comments. Mrs. Istvan also guided and documented the comment resolution and adjudication process, and she staffed the final document through the ASC Standardization Executive.

Chris Ptachik, a SAF/AQRE contractor, supported the Air Force DepSO by analyzing and comparing the NIJ standard to military purchase descriptions, reviewing procurement histories to assess use of the NIJ standard, preparing draft procurement guidance, coordinating with NIJ and NIST on revising the NIJ standard, preparing the advocacy presentation, planning and coordinating the joint meeting on developing a body armor standard, and setting up and administering the Body Armor Standard CoP. Mr. Ptachik also participated in drafting the document and resolving review comments, and he staffed the final document for Air Force Standardization Executive approval.

DLA Accepts Alternative, Environmentally Friendlier Finishes for Electrical Connectors

Award Winner: Abdonasser Abdouni



Abdonasser Abdouni, of the Defense Supply Center Columbus (DSCC), led an effort to develop alternative finishes for high-reliability electrical circular connectors in lieu of traditional finishes that rely on cadmium (Cd), a hazardous chemical. The military services have used Cd connector finishes for many years, largely because alternatives to cadmium could never pass the military's stringent environmental tests. Through Mr. Abdouni's efforts, three new finishes—zinc nickel, nickel fluorocarbon polymer, and pure dense electrodeposited aluminum—have successfully passed the tests. The new finishes were included in MIL-DTL-38999L, "General Specification for Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts," issued on May 30, 2008. Not only does this effort support DoD's efforts to minimize the use of hazardous material, but it will enable DoD to avoid costs conservatively estimated at more than $20.9 million over the next 5 years.

Background

Cd finishes have been used on electrical connectors for more than 30 years in DoD applications. Connectors with Cd finishes have excellent performance characteristics when used in the most demanding environments such as maritime applications that require the ability to withstand high levels of salt-spray corrosion. The military requires the finishes to pass a 500-hour salt-spray corrosion test. Alternatives to Cd finishes have been available for some of the defense specifications, but none could match the performance capabilities of Cd for salt-spray corrosion, as well as for lubricity.

In the last 5 to 10 years, the use of Cd has become an environmental issue because exposure to Cd is hazardous to humans. The European Union addressed this issue by adopting, in February 2003, the Restriction of Hazardous Substances Directive. This directive places stringent restrictions on the use of cadmium in commercial and industrial applications; to be considered compliant with the directive, the amount of Cd used in an application must be less than 0.01 percent by weight. Similarly, DoD and the Defense Logistics Agency (DLA) have initiated hazardous material minimization programs whose goals are to lead the military to consider alternatives to problematic materials.

Problem/Opportunity

Not only are military customers looking for alternatives to Cd finishes, but the manufacturers of electrical connectors have devoted considerable resources to investigating new Cd-free finishes that would meet the demanding military operational needs. DSCC, in its role of specification preparing activity for electrical connector defense specifications, monitored these developments.

At the May 2006 meeting of SAE International's subcommittee on electrical connectors, the industry proposed that DSCC consider four new Cd-free finishes (zinc nickel, nickel fluorocarbon polymer, aluminum, and zinc cobalt) for incorporation into the widely used circular connector specification program, MIL-DTL-38999. If successful, this effort would, for the first time, result in thousands of new standard electrical connectors using finishes other than cadmium. These connectors would have hundreds of applications that must satisfy high-performance requirements, including salt-spray corrosion testing. This effort would also support DoD/DLA efforts to minimize the use of parts with a Cd finish.

Approach

A special project to identify alternative Cd-free finishes for standard electrical connectors under MIL-DTL-38999 began in spring 2007. The project's focus was to meet the needs of military customers and to address an industry consensus that new standard parts were needed. This project also supports the DoD and DLA Green Procurement initiative to buy less hazardous material for DoD use by providing alternatives to the use of hazardous Cd finishes on connectors.

In addition to successfully concluding an engineering practices study that laid the groundwork with the military departments and industry for the engineering approach to the problem, a DoD standardization project was initiated to incorporate the four proposed Cd-free finishes into MIL-DTL-38999. A draft of Revision L to MIL-DTL-38999 was circulated in April 2007 to all military services, equipment contractors, and electrical connector manufacturers for technical review. A military/industry meeting at DSCC was held in October 2007 to resolve all of the engineering and technical comments received on the draft of MIL-DTL-38999L. As a result of the coordination meeting, technical consensus was reached in the military and industry to incorporate three of the proposed Cd-free finishes. The performance of the three finishes—zinc nickel, nickel fluorocarbon polymer, and electrodeposited aluminum—is comparable to that of Cd-based finishes. Specifically, they withstand the 500-hour salt-spray corrosion test.

Outcome

As a result of Mr. Abdouni's efforts, the widely used MIL-DTL-38999 has a set of three new Cd-free finishes to meet the needs of the military services. The three new finishes introduce approximately 21,000 new standard electrical connector part numbers into the specification. The new parts, which are required to pass the stringent 500-hour salt-spray corrosion test, are of the highest quality and reliability and can be used in the most demanding military applications. The specification change will eventually affect many major military weapon systems that today depend on MIL-DTL-38999 part numbers.

More than 7,000 national stock numbers are associated with MIL-DTL-38999 connectors that use Cd finishes. Without the specification change to include the Cd-free finishes, it is conservatively estimated that over the next few years, each manufacturer would introduce its own series of parts to meet the military services' needs to move away from hazardous materials such as Cd finishes. Moreover, equipment contractors would use fewer standards in source control drawings. To put it another way, by adding a comprehensive set of Cd-free parts in MIL-DTL-38999, DoD precluded the introduction of at least 200 nonstandard connectors annually into the inventory system. Using the DoD parts management cost avoidance estimate of $20,904 for each nonstandard electrical connector, this effort will save more than $4 million annually, or nearly $21 million over the next 5 years. This conservative estimate was based on only one comparable nonstandard part entering the inventory system. However, considering the number of manufacturers that will eventually provide these products, the updated specification will likely preclude the introduction of at least three to five nonstandard parts for each standard connector that will be available.

In addition to the cost avoidance associated with precluding the introduction of nonstandard parts, this effort will facilitate the standardization and logistics planning of the military services to move entire weapons systems and their interconnection systems from Cd-based finishes to the alternative finishes, thereby ensuring interoperability of the major systems involved. To plan the transition from Cd-based interconnection systems, program offices and their logistics support offices must have a complete set of both the electrical connectors and receptacles for the transition to occur effectively.

Current Status

MIL-DTL-38999L was approved on May 30, 2008. Information on this defense specification is available on ASSIST (http://assist.daps.dla.mil/online/start/) as well as on the website of DSCC's Document Standardization Unit (http://www.dscc.dla.mil/Programs/MilSpec/DocSearch.asp/).

All 17 connector manufacturers on the qualified products list are in the process of qualification testing against the new requirements to become qualified for the alternative finishes.

Challenges

The successful completion of the MIL-DTL-38999L project required the commitment of resources by the affected parties. In particular, the project required a significant commitment of engineering resources—by connector manufacturers, equipment contractors, the military services, and DSCC—to develop and review drafts, debate and resolve comments, and attend military/industry meetings. In addition, connector manufacturers in-

curred the costs of qualification testing of the new finishes; they should recoup those costs later in downstream orders.

Political attention was another challenge. The military services, DLA, and the Office of the Assistant Secretary of Defense are paying considerable attention to the development of less hazardous materials and products. This project is now being tracked as a DoD/DLA Green Procurement project, and its successful completion is a major hazardous material minimization success story.

Finally, the most difficult and significant obstacles to be overcome were the technical and engineering challenges of this project. Not only was it necessary for the various competitive manufacturers to reach consensus on the engineering requirements for the final three alternative finishes, but all of the engineering details on how to specify and test these connectors had to be resolved. In addition, successful completion of this project required reaching consensus on the method of differentiating these parts from the existing part numbers, the engineering requirements and corresponding verification tests, and the qualification procedures. Other contentious engineering requirements, such as lightning-strike survivability, also had to be addressed.

This effort by Mr. Abdouni required not only an exemplary application of engineering skills and knowledge, but just as important, the ability to lead the various competing factions in the successful resolution of comments to achieve a final specification.

About the Award Winner

Abdonasser Abdouni, an electronics engineer, is chief of the Interconnection Branch at DSCC's Operations Support Directorate, Document Standardization Division. The decision to pursue the development of alternative connector finishes was due to his collaboration with industry and participation in meetings of SAE International's connector subcommittee. He and his engineering team visited multiple connector manufacturers to observe new plating finishes and processes. Considering the engineering information obtained during those visits, Mr. Abdouni initially proposed the inclusion of four new finishes (zinc nickel, nickel fluorocarbon polymer, aluminum, and zinc cobalt) as alternatives to cadmium. Under his direction, his team drafted MIL-DTL-38999L and circulated it to military and industry entities for comments. Mr. Abdouni chaired the military/industry coordination meeting in October 2007 and resolved more than 130 engineering and technical comments on the draft, reaching a consensus with a broad segment of industry and military representatives, which allowed the final specification to move forward for approval. His actions demonstrate an outstanding commitment of engineering ingenuity and resourcefulness, as well as the ability to work constructively with a broad segment of military and industry entities.

DISA Advocates Standard Profiles

Award Winner: Ralph Liguori

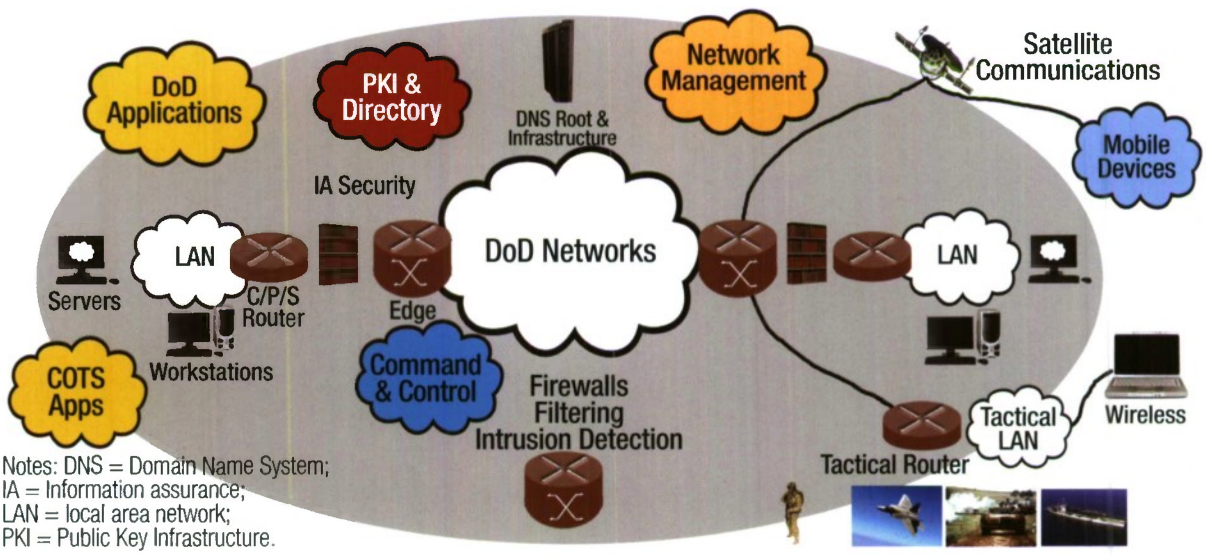
Ralph Liguori, of the Defense Information Systems Agency (DISA), led the way to carry out the mandate of the Office of the Secretary of Defense (OSD) to ensure the maintenance of DoD-wide product interoperability through the use of Internet Protocol Version 6 (IPv6). In particular, Mr. Liguori chaired a working group to develop "DoD IPv6 Standard Profiles for IPv6 Capable Products." The initial version of this document, issued in May 2006, was a list of IPv6 products that are developed, procured, or acquired by DoD. Version 3.0 of the document was approved in July 2008. Mr. Liguori also worked closely with the Joint Interoperability Test Center (JITC) in establishing an IPv6 Certification Program, based on the IPv6 product profiles, to test DoD vendor products. Products that pass the tests are placed on an IPv6 approved products list (APL) to be used for acquisitions throughout DoD.

Background

To realize the DoD vision of a Global Information Grid (GIG), the DoD Chief Information Officer (CIO) called for a dependable, reliable, and ubiquitous network that eliminates stove-pipes and responds to the dynamics of the operational scenario—bringing "power to the edge." To construct this transport infrastructure, DoD is following the Internet model. The Internet Protocol is a key component of the Internet model transport infrastructure, which is the foundation for the net-centric transformation in DoD and the intelligence community. DoD systems are being designed and built to follow the Internet model with the goal of becoming "plug-and-play" building blocks of the GIG.

The DoD CIO recognized that DoD's planned systems and constructs—for example, the Army's LandWarNet, the Navy's FORCEnet, and the Air Force's C2 Constellation—could not fully transform to net-centric operations without DoD's transition from IPv4 to IPv6. Figure 1 depicts the components that must make the transition to IPv6.

FIGURE 1. Components of DoD's IPv6 Transition



Notes: DNS = Domain Name System;
IA = Information assurance;
LAN = local area network;
PKI = Public Key Infrastructure.

Below are key IPv6 enhancements over IPv4 in support of net-centric operations:

- Significantly increased capability for deploying large numbers of networks and connected nodes
- Secure auto-configuration and discovery
- Improved mobility and ad hoc networking
- Integrated strong confidentiality, integrity, and authentication for information assurance
- Improved quality of service for real-time communications
- Simplified network administration
- Significantly easier integration of data from disparate systems and sensors
- More efficient use of bandwidth for real-time services (voice and video)
- Reduced complexity for implementation of future advanced capabilities.

In June 2003, the DoD CIO issued a policy memorandum on the transition to IPv6. The new policy stated that starting October 1, 2003, all GIG assets being developed, procured, or acquired must be IPv6 capable as well as interoperable with IPv4 systems and capabilities. An IPv6-capable system must be able to operate on or coexist with a network supporting IPv4 only, IPv6 only, or a hybrid of IPv4 and IPv6. The DoD goal was to complete the transition to IPv6 for all networking across DoD by FY08. Also, in August 2005, the Office of Management and Budget issued Memorandum M-05-22, "Transition Planning for Internet Protocol Version 6 (IPv6)," establishing the goal of enabling all federal government agency network backbones to support the next generation of the IPv6 by June 30, 2008.

Problem/Opportunity

Ensuring that all GIG assets being developed, procured, or acquired are IPv6 capable—and thus ensuring interoperability throughout DoD—meant that the initial IPv6 requirements needed to be defined. An ad hoc IPv6 working group consisting of DoD services and agencies undertook that task. The group was established in July 2003 under the auspices of the Joint Technical Architecture (JTA) Development Group.

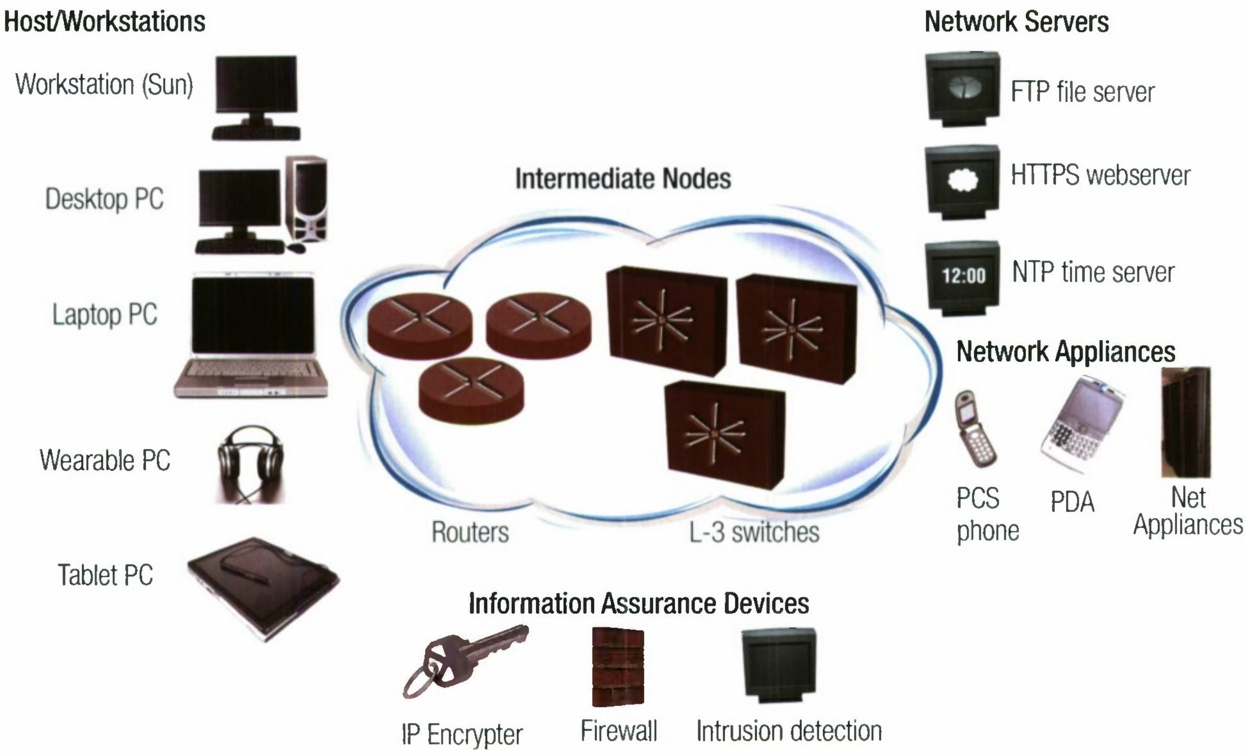
Chaired by Mr. Liguori, the group developed the first DoD IPv6 standards profile, which consisted of the IPv6 standards that must be supported for products to be considered IPv6 capable. On September 29, 2003, the DoD CIO issued a memorandum requiring IPv6-capable products to conform with the JTA-developed IPv6 standards profile.

In July 2004, the DoD Information Technology Standards Registry (DISR) replaced the JTA, and the JTA IPv6 standards profile became the DISR IPv6 Generic IPv6 Standards Profile. The DISR profile, like the JTA profile, consisted of a single list of IPv6 standards. Vendors could then choose the standards that were applicable to their products.

Approach

Mr. Liguori recognized the need to have separate standards profiles for specific IPv6 equipment types, such as workstations, routers, and servers. Therefore, he proposed developing IPv6 standards profiles for various product classes, with the new DISR IPv6 Technical Working Group (TWG) responsible for maintaining the IPv6 standards requirements. The DISR IPv6 TWG issued Version 1.0 of "DoD IPv6 Standard Profiles for IPv6 Capable Products" in 2006 with the support of industry IPv6 organizations. Version 1.0 includes IPv6 standards profiles for five IPv6-capable product classes: host/workstations, network appliances, network servers, intermediate nodes (routers and L-3 switches), and information assurance devices. (See Figure 2.)

FIGURE 2. IPv6-Capable Product Classes



Also, an IPv6 questionnaire was developed for DISRonline based on the profile document to assist services and agencies with preparing their acquisition requirements for IPv6 products. In addition, JITC developed its IPv6 generic test plan based on IPv6 requirements outlined in the profile document. JITC tests vendors' products for acceptance on the DoD IPv6 APL.

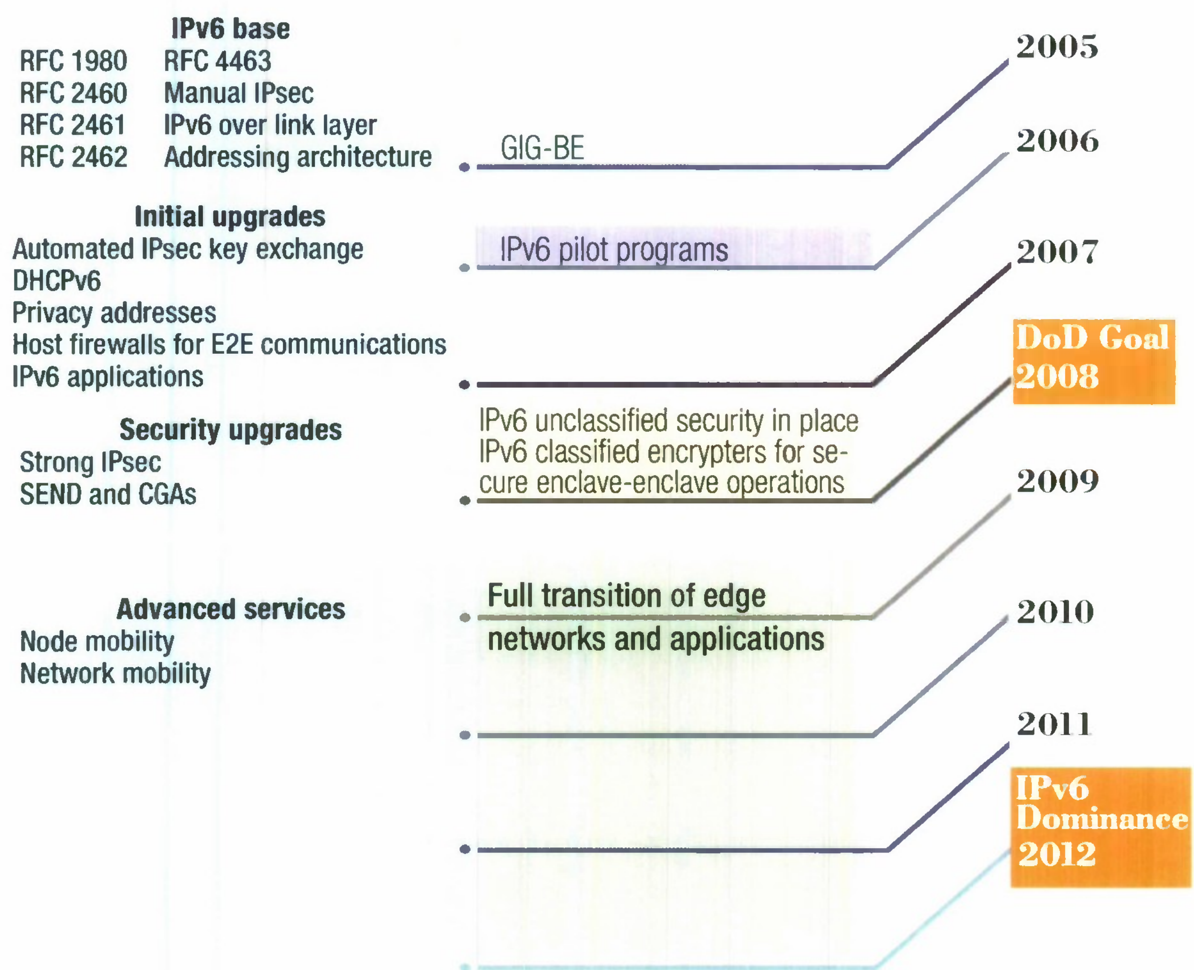
As work continued to enhance and upgrade the IPv6 standards profiles, Mr. Liguori realized that determining whether IPv6 standards should be entered into the DISR as mandated or emerging was only the first step to promoting IPv6 interoperability. He convinced the IPv6 TWG to put together a set of IPv6 standards (a standards profile) that

had to work together to ensure IPv6 interoperability and compliance. This required defining the IPv6 base requirements that all devices had to meet and defining the mandatory and optional functional requirements for each product type. An example of an optional functional requirement is the Transition Mechanism Standards Profile for nodes that interoperate with IPv4.

Another development effort addressed security, a technically complex function that must be included in all IPv6 nodes. Mr. Liguori collaborated extensively with the National Security Agency (NSA) member of the IPv6 TWG to develop clear IPv6 security standards guidance. That guidance, contained in Appendix E of "DoD IPv6 Standard Profiles for IPv6 Capable Products," cites NSA policy for IP security encryption, authentication, key management, and so on.

Figure 3 identifies the key IPv6 technical insertion goals and the timeline for attaining them.

FIGURE 3. Key Protocol Technical Insertion Goals



Notes: CGA = cryptographically generated addresses, DHCP = Dynamic Host Configuration Protocol, E2E = end to end, GIG-BE = Global Information Grid-Bandwidth Expansion, IPsec = Internet Protocol security, RFC = request for comments, and SEND = SEcure Neighbor Discovery.

Outcome

"DoD IPv6 Standard Profiles for IPv6 Capable Products" has several benefits:

- *Defines the requirements for the IPv6 products procured throughout DoD.* Joint service and agency project and program managers use the profiles document when developing JTA technical views. They also use it for procurement and testing of IPv6-capable products. The document provides an identical minimum set of standards by product type (router, switch, server, etc.) and mandatory functions to ensure interoperability, and it stops the proliferation of standalone IPv6 products. It also describes optional functions that may be implemented, as long as it is done consistently to ensure interoperability.
- *Saves significant development and production testing costs, and supports the JITC.* The JITC IPv6 APL identifies the DoD vendor products tested and approved in accordance with the IPv6 product profiles. Also, the JITC IPv6 certification program is funded by the vendors seeking IPv6 certification to be placed on the DoD IPv6 APL. This improves interoperability throughout DoD by ensuring that the products meet the IPv6 requirements, and it saves costs associated with testing. Cost savings for testing are estimated at $1 million per year based on a cost of $50,000 per test times 20 vendor products tested per year.
- *Saves product development costs.* The DoD IPv6 implementation strategy leverages commercial off-the-shelf (COTS) technology, which must be available and mature to sustain the implementation effort. Customer demand drives COTS product availability, and product maturity is driven by customer testing and deployment. The DoD CIO's June 2003 IPv6 policy memorandum and the subsequent DoD IPv6-capable requirements signaled future demand to vendors that accelerated the development of IPv6 products. This is an enormous saving in IPv6 product development.
- *Promotes competition among vendors.* The lowest-cost JITC-certified vendor product for each device type has the best chance of being selected for DoD acquisitions.
- *Promotes interoperability with the federal community.* The National Institute of Standards and Technology (NIST) has essentially adopted "DoD IPv6 Standard Profiles for IPv6 Capable Products" to develop an IPv6 standard profiles for the U.S. government. Establishment of government-wide standard profiles will ensure that operations between DoD and the federal community, like the Department of Homeland Security, will be interoperable.
- *Supports the OSD mandate for the transition to IPv6-capable products by 2008.*

Current Status

A June 2008 DoD CIO memorandum updated the definitions of DoD IPv6-capable

products and mandated that IPv6-capable products conform to "DoD IPv6 Standard Profiles for IPv6 Capable Products."

Version 3.0 of "DoD IPv6 Standard Profiles for IPv6 Capable Products" was approved for use in July 2008. It is being used throughout DoD for procuring IPv6 products. In addition, JITC has updated its IPv6 certification testing to reflect the updated IPv6 product requirements.

Mr. Liguori is working closely with the Internet Engineering Task Force (IETF) to insert new IPv6 technology that meets DoD needs—for example, Network Mobility, which manages the mobility of an entire network when it changes its point of attachment to the Internet while moving information—into updated versions of "DoD IPv6 Standard Profiles for IPv6 Capable Products."

Challenges

The major hurdle to defining IPv6 requirements was the maturity of the IPv6 standards and the availability of IPv6-capable products when the DoD IPv6 mandate was issued in June 2003. IPv6 technology is still evolving in the IETF. The base IPv6 protocols are now stable and mature, and some product implementations are available, but many of the standards supporting upgraded IPv6 features are still evolving.

Another problem was not having a laboratory to test combinations of IPv6 standards to understand how they work together. Mr. Liguori collaborated with his counterparts in the Army and JITC to get selected IPv6 standards implemented in IPv6-capable products, like routers. Those prototype products were then tested to ensure that the IPv6 standards selected for inclusion in the profile would work end to end and support interoperability.

Finally, Mr. Liguori has worked with a shrinking budget to continue to maintain "DoD IPv6 Standard Profiles for IPv6 Capable Products" with annual updates that contain the latest IPv6 technology that meets DoD needs.

Throughout the development of the IPv6 product profiles, Mr. Liguori recognized the importance of industry involvement. He worked with IPv6 experts at IETF and the North American IPv6 Task Force (NAv6TF). IETF and NAv6TF representatives were invited to participate in the IPv6 TWG meetings when it was developing the IPv6 product profiles. Also, Mr. Liguori recognized the importance of working extensively with NIST representatives to ensure interoperability with IPv6 products throughout the federal government—both defense and civil agencies.

About the Award Winner

Ralph Liguori has led the DoD effort to define the IPv6 requirements since the DoD CIO mandated the transition to IPv6 in June 2003. He chaired the JTA IPv6 ad hoc working group that was established in July 2003 to define the initial IPv6 requirements. As the IPv6 TWG chair, he led the development of the IPv6 product profiles to improve the definition of the IPv6 requirements for various product classes. Mr. Liguori also worked closely with the JITC to help it use these definitions; that effort became the basis for JITC testing of vendor IPv6-capable products. He ensured that all "must," "shall," and "should" requirements cited in each IPv6 standard would be regressively tested using software. He has also supported the DoD IPv6 Transition Office, which is using "DoD IPv6 Standard Profiles for IPv6 Capable Products" as a tool for ensuring service and agency compliance with the OSD IPv6 mandate.

Program News

Topical Information on Standardization Programs

DSP Recognizes Achievements in Standardization

Annually, the DSP recognizes individuals and teams from the military departments and defense agencies who have achieved significant improvements in interoperability, cost reduction, quality, reliability, and readiness through standardization. Since 1987, DSP has recognized these outstanding performers in a formal ceremony, usually held during the DoD Standardization Conference. This year, however, the ceremony, held on March 12, was a standalone event that took place in the Pentagon's Hall of Heroes. Mr. Greg Saunders, Director, DSPO, officiated the ceremony with help from Mr. Alan Estevez, Principal Assistant Deputy Under Secretary of Defense for Logistics and Materiel Readiness.

Tim Sharpe, of the Defense Information Systems Agency, was the 2008 Distinguished Achievement Award winner for his work with 15 NATO nations to develop a standard interface between national tactical systems to form a federated network. Mr. Sharpe received an engraved crystal Pentagon and a check for $5,000.

The remaining awards were presented to five teams and two individuals:

- Joint Army/Defense Logistics Agency team, for its work on palletization standards
- Army team, for its work on a supersonic particle deposition process called "cold spray"
- Navy team, for its work on developing a Virtual Tactical Bridge for seamless communications in various service training environments
- Joint team, for its work on creating a common Joint Deficiency Reporting System
- Air Force team, for its work on the development of performance standards and test protocols for soft and hard body armor
- Abdonasser Abdouni, of the Defense Supply Center Columbus, for his work on developing alternative finishes for high-reliability electrical circular connectors
- Ralph Liguori, of the Defense Information Systems Agency, for his work on developing standard profiles to ensure the interoperability of DoD products through the use of Internet Protocol Version 6.

2008 Distinguished Achievement Award Winner

Standard Interface between National Tactical Systems

Pictured above are, left to right, Mr. Gregory Saunders, Mr. Alan Estevez, Mr. Tim Sharpe, Mr. Richard Williams, Mr. Michael Morgan, and Mr. Michael O'Connor.

Achievement Award Winners

Palletization Standards

Pictured above are, left to right, Mr. Alan Estevez, Mr. Thomas Kozlowski, Mr. Kenneth Hill, Ms. Ann Podrasky, Mr. Joseph Wolak, Mr. Francis Flynn, Mr. Timothy Keller, LTG James Pillsbury, Mr. Mark Scott, Mr. Ron Davis, and Mr. Luis Garcia-Baco.

Supersonic Particle Deposition Process

Pictured above are, left to right, Mr. Alan Estevez, Mr. Richard Squillacioti, Mr. Victor Campagne, Dr. Dennis Helfritch, Mr. Michael Maher, COL Bobby Smith, LTG James Pillsbury, Mr. Ron Davis, and Mr. Luis Garcia-Baco.

Achievement Award Winners

Virtual Tactical Bridge

Pictured above are, left to right, Mr. Alan Estevez, Mr. Robert Reif, Mr. Christopher Sprague, Mr. Lance Legan, Mr. John Allen, Mr. Gary Fraas, CAPT Kevin Redman, and Mr. Scott White.

Joint Deficiency Reporting System

Pictured above are, left to right, Mr. Alan Estevez, Mr. Steven Hauck, Ms. Lorilee Crisp, Mr. William Queener, Mr. William Duren, Mr. William Folsom, Mr. Nidel Deeb, Ms. Mary Jones, Mr. Pat McCann, CAPT Joseph Baker, CAPT Kevin Redman, and Mr. Scott White.

ACHIEVEMENT AWARD WINNERS

Military-Unique Standard for Soft and Hard Body Armor

Pictured above are, left to right, Mr. Alan Estevez, Mrs. Madeleine Istvan, Mr. Timothy Staley, Mr. Chris Ptachik, Capt James D'Amato, Mr. Robert Marshall, Ms. Anne Kreider, Mr. Gerry Freisthler, Mr. Larry Taranto, Mr. Terry Jaggers, and Mr. John Heliotis.

Finishes for Electrical Circular Connectors

Pictured above are, left to right, Mr. Alan Estevez, Mr. Abdonasser Abdouni, Mr. Thomas Hess, BG Patricia McQuistion, Mr. Bill Lee, and Ms. Christine Metz.

Achievement Award Winners

Standard Profiles for IPv6-Capable Products

Pictured above are, left to right, Mr. Alan Estevez, Mr. Ralph Ligouri, Mr. Richard Williams, Mr. Dave Brown, and Mr. Michael O'Connor.

DSPO Staff Hosts a Meeting with U.S. NATO Participants

U.S. standardization work with NATO and our European Union partners is an important part of day-to-day DSPO work. Recently, our staff hosted a meeting with U.S. NATO participants to go over the background and changes in the newly revised AAP-03, "Directive for the Production, Maintenance and Management of NATO Standardization Documents." This publication tightens up the procedures for development of standardization agreements and focuses them squarely on accomplishment of interoperability requirements needed to achieve NATO capabilities. It also introduces a new kind of document called a standardization recommendation (STANREC). The STANREC will be an expedited method of introducing standard best practices that are not necessarily focused on interoperability but will improve the efficient use of resources. STANRECs will not have to go through a ratification process in order to be promulgated. For more information on AAP-03 and the new concepts introduced in the revision, please contact our office.

The DSPO Director also recently participated in a meeting of the Material Standards Harmonization Team in Brussels. This group is sponsored by the European Defense Agency but is open to all friendly nations. The group's goal is to identify best practices and preferred standards for use in defense procurement. At the meeting, held on July 3, the group heard a report on a study on involvement of industry in defense standardization. Although the study focused on European industry and European defense establishments, many of the questions addressed issues that are common to ones that we face, such as views on prescriptive- and performance-based standards, views on maintaining defense requirements in civil standards, problems encountered with standards in the contracting process, and problems encountered with the maintenance of old equipment built to standards that have been superseded. The full report of the study is due to be released at the end of July. Information on how to obtain copies is not available at this time but once we know, we will post information on the DSP website.

Events

Upcoming Events and Information

August 17–18, Toronto, Canada
58th Annual SES Conference

Rob Steele, Secretary General, ISO, will present the keynote address at the 58th annual SES conference August 17–18, 2009, in Toronto, Canada. This year's conference will highlight sessions on standards development, usage, and innovation presented by experts from industry, government, and standards developing organizations. For more information or to register, please go to www.ses-standards.org.

September 21–24, 2009, Orlando, FL
DMSMS and Standardization Conference

DSPO will be holding its annual conference in conjunction with the Diminishing Manufacturing Sources and Material Shortages conference. The conference will be held September 21–24, 2009, and will take place at the Rosen Centre, in Orlando, FL. The theme for this year's conference is "New Directions and Challenges." The conference will focus on strategic partnerships, visibility into total ownership costs, opportunities for partnering, and standardization enablers. For more information on the conference, including the agenda, or to register, please go to www.dmsms-stdz2009.com.

October 7, 2009, Washington, DC
U.S. Celebration of World Standards Day

On October 7, 2009, leaders of business, industry, academia, and government will gather in Washington, DC, to join with consumer representatives and experts in science and technology for a celebration of the relationship between standards and the global environment. The 2009 U.S. Celebration of World Standards Day will focus on standards for environmental stewardship, recognizing the critical role that standards and conformity assessment programs play in environmental protection and preservation, from sustainable products and buildings to greenhouse gas reduction and energy conservation. For more information, please go to www.wsd-us.org.

Upcoming Issues
Call for Contributors

We are always seeking articles that relate to our themes or other standardization topics. We invite anyone involved in standardization—government employees, military personnel, industry leaders, members of academia, and others—to submit proposed articles for use in the *DSP Journal*. Please let us know if you would like to contribute.

Following are our themes for upcoming issues:

Issue	Theme
July–September 2009	Interoperability
October–December 2009	Warfighter Support

If you have ideas for articles or want more information, contact Tim Koczanski, Editor, *DSP Journal*, Defense Standardization Program Office, 8725 John J. Kingman Road, STP 5100, Fort Belvoir, VA 22060-6220 or e-mail DSP-Editor@dla.mil.

Our office reserves the right to modify or reject any submission as deemed appropriate. We will be glad to send out our editorial guidelines and work with any author to get his or her material shaped into an article.


DEFENSE STANDARDIZATION PROGRAM
MAKING SYSTEMS WORK TOGETHER